MACHINE DESIGN

PARTS • MATERIALS • METHODS • FINISHES

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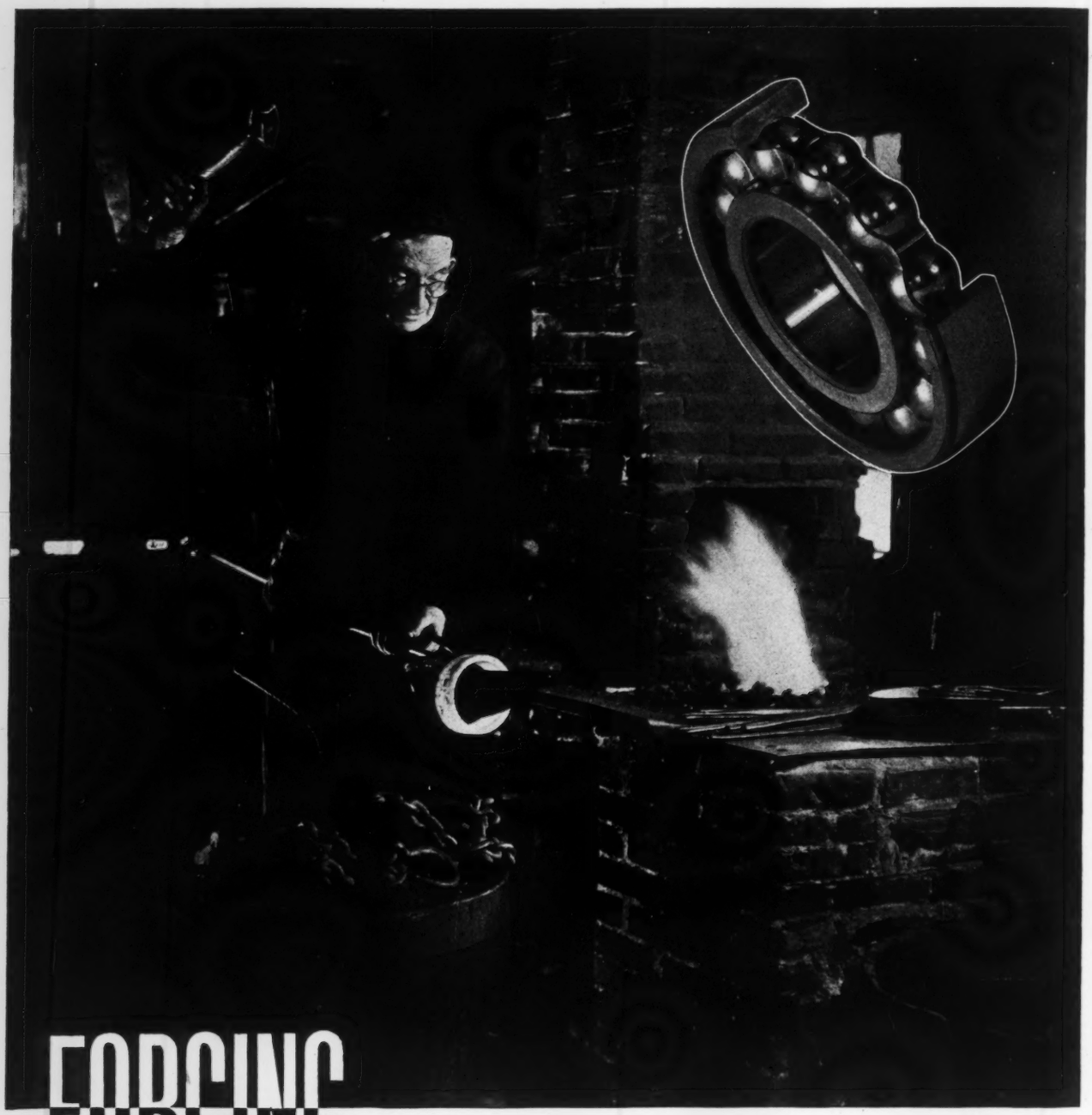

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THE *FORGED STEEL* BEARING

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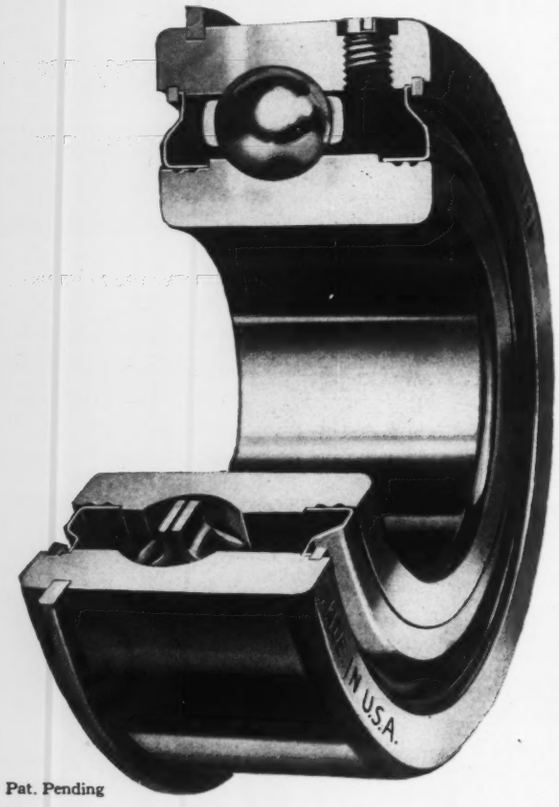
REVOLU

SIMPLIFY AND SAVE
With This
IDEAL SELF-SEALED BEARING



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Made to standard double-row widths.

Available in Four Different Series

"3600" . . . . . with standard outer ring.
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TO "Simplify and Save" is the avowed aim of every progressive motor and machine designer. It is the economic doctrine preached by good management. It is made obligatory by competition.

In ball bearings, this aim is achieved in a highly practical way by the use of NORMA-HOFFMANN "CARTRIDGE" self-sealed ball bearings, as illustrated here and on the page opposite.

A revolutionary departure from orthodox design, the "CARTRIDGE" self-sealed ball bearing provides inherent features which, until now, could be incorporated in motors or machines only by elaborate, complex and costly external means.

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Thoroughly tested for several years in our laboratory and in the field under continuous duty, this bearing has demonstrated not alone its value and efficiency but ITS SUPERIORITY. Already a number of representative manufacturers of motors and other units have adopted it. It bids fair to be the bearing of the future, representing—as the advantages on the page opposite strikingly denote—a real forward step in simplifying design and in insuring improved efficiency, long, uninterrupted performance and absolute cleanliness.

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Ask for Catalog F-951-B, *containing full details and typical "Cartridge" mountings.*

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Now-the right TYPE and SIZE of ARC for every JOB...

NOW, the heat of the welding arc can be varied as to *type* as well as to *intensity*... tuned for every job to give maximum speed and quality everytime.

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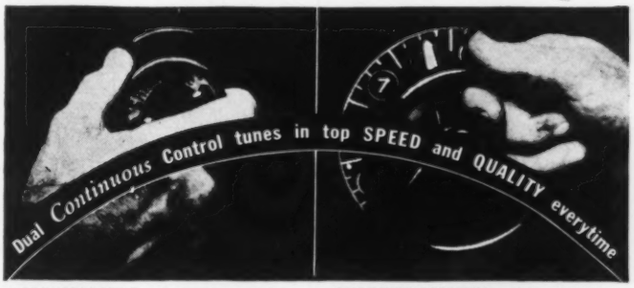

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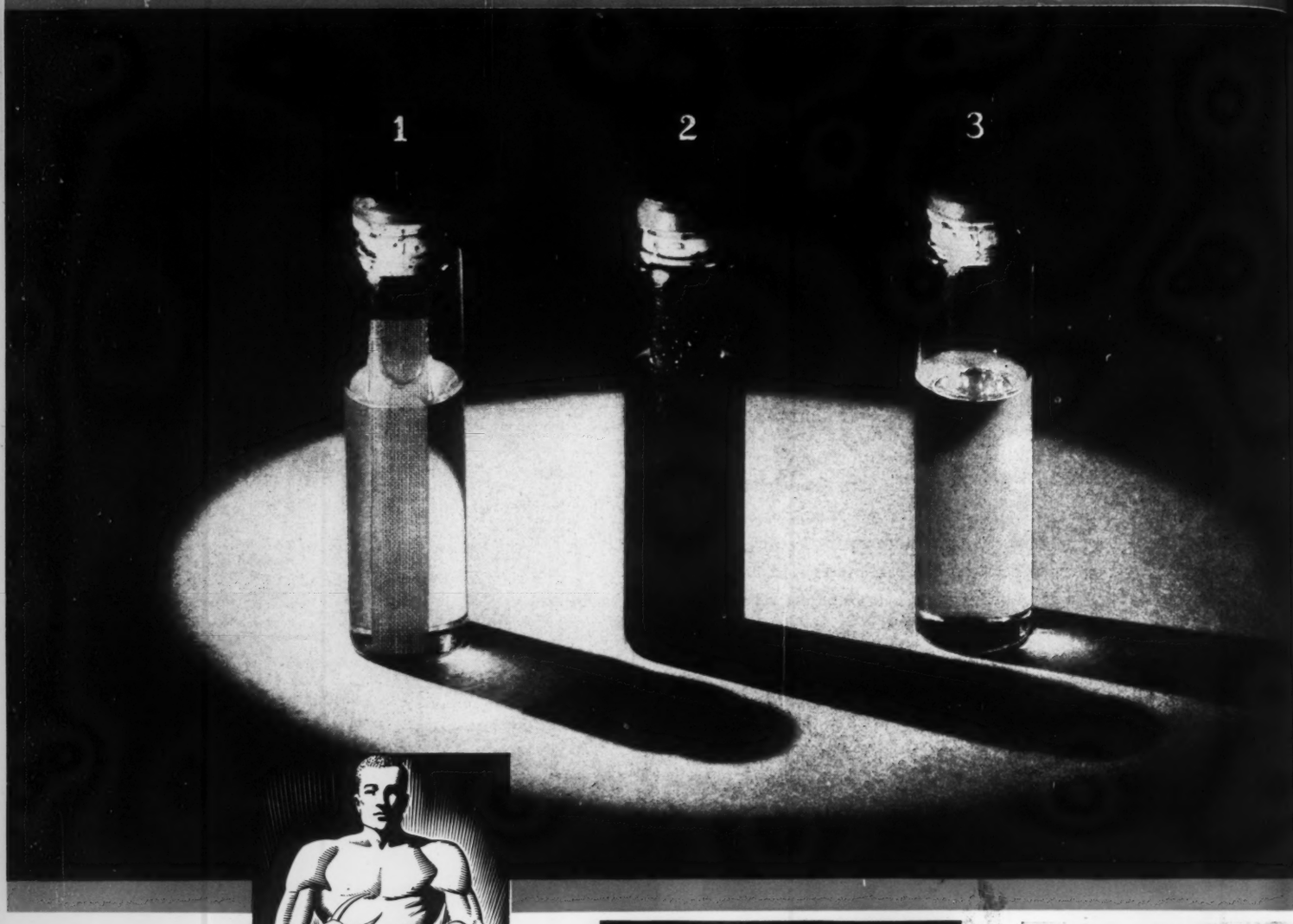
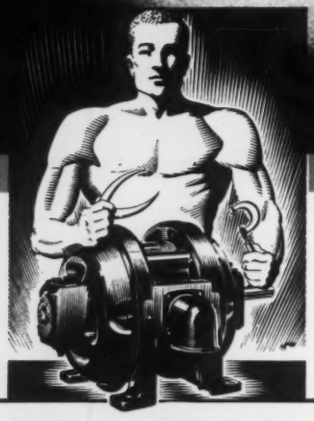
A MOTOR-INSULATION



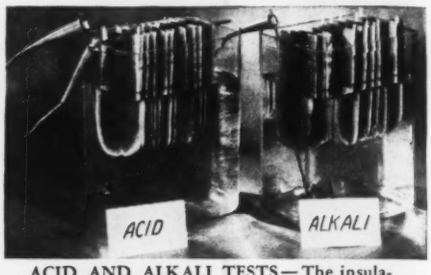


G-E MOTORS PASS ALL TESTS

MOISTURE TEST—In the supersaturated atmosphere of this fog room, the windings of G-E induction motors had to pass an extra-severe moisture test

ABRASION TEST—For resistance to abrasion, enameled wire is tested on this machine, which scrubs the enamel film with superhard Carboloy bars

BONDING-STRENGTH TEST—The extra-high bonding strength of G-E insulating varnish, proved conclusively by this test, gives G-E motors longer life



ACID AND ALKALI TESTS—The insulation of G-E motors is tested for acid and alkali resistance to make sure that the windings will be protected against these corrosives

INJURY - RESISTANCE DEMONSTRATION—The above photograph shows the high mechanical - injury resistance which the Glyptal armor gives the end windings of G-E induction motors

GENERAL ELECTRIC

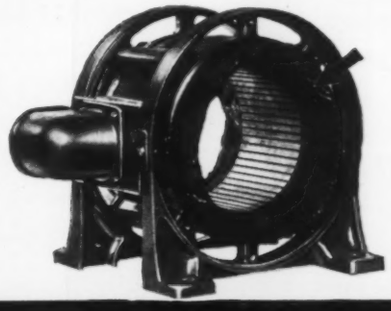
STORY IN THREE BOTTLES

TWENTY-ONE months ago these three bottles were filled with lubricating oil. To Bottle No. 1 was added a sample of G-E motor-insulating varnish; to Bottle No. 2, a sample of another motor-insulating varnish which is widely used; to Bottle No. 3, nothing was added.

At the end of one week the oil in Bottle No. 2 had begun to darken—the varnish could not resist the concentrated action of the oil. Thirty days later the oil had completely destroyed the varnish—robbed it of its insulating properties, reduced it to a black, soggy mass.

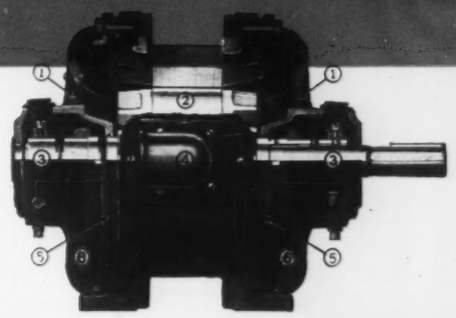
At the end of the first month the oil in Bottle No. 1 was just as clear as the oil in Bottle No. 3. Twenty months later the conditions, as can be seen from the illustration at the left, were still unchanged. This is proof that the varnish used in protecting and bonding the windings of G-E random-wound motors has high resistance to oil—proof that the insulation in G-E motors will protect the windings throughout the long life of the motor.

This is only one of the many tests to which materials and methods were submitted in the development of the insulation used in G-E random-wound stators. Others included tests for resistance to moisture, acid and alkali, abrasion, and mechanical injury. They are your assurance of long motor life and low maintenance costs. Buy motors with insulation that passes *all* the tests. They pay bigger dividends.

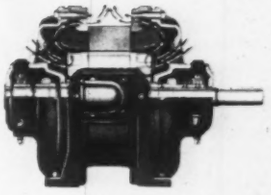


Extra protection is given to the end windings of G-E induction motors by special Glyptal treatments which effectively protect the windings against mechanical injury. As shown at the left, below, not even smashing hammer blows can injure them

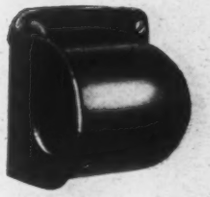
Inspecting samples of motor-insulating varnishes after 21 months' exposure to the concentrated action of lubricating oil. The sample of a widely used varnish was completely destroyed. The sample of G-E varnish was still intact—it had all of its insulating properties



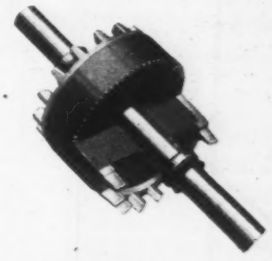
How You Save by Using G-E Induction Motors



1. Double-end, low-velocity ventilation effectively cools G-E motors, helps to keep them clean, and reduces maintenance costs

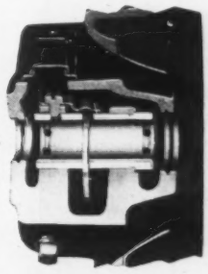


4. You save time in making connections in these roomy conduit boxes, which can be mounted in four positions. Leads with terminals save time, too



2. Indestructible cast-aluminum rotors, with integrally cast fans, have no joints to cause high resistance spots

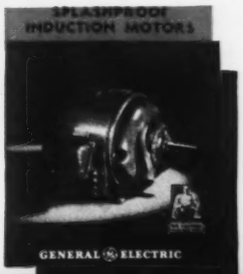
5. Convenient knockoff ledges save time in disassembling the motor. No special tools required. No danger of damaging the motor



3. Steel shell, babbitt-lined sleeve bearings, sealed against dust and dirt, assure long life of bearings and low maintenance costs

6. Strong, cast-iron end shields on all G-E induction motors provide accurate bearing alignment and uniform air gap

SEND TODAY FOR NEW, FREE BULLETIN



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Schenectady, N. Y.

Please send me a copy of this bulletin (GEA-1619B) on your new splashproof motors.

Name.....

Company.....

Address..... 020-270

Topics . . .

NO MATTER how carefully the designer may do his job, or how excellent the machine operates after it has been constructed, if the final result is not what the prospective purchaser wants it might just as well have never been conceived. Consideration of the user is a major part of the designer's development work, and the method of determining just what the user desires is extremely important. One of the best means of uncovering these facts is the General Motors widely-distributed questionnaire booklet. First, it is extremely simple to give one's preference—typical sketches of different designs are included and it is merely necessary to check the one thought best. Further, the booklet goes completely into design details and there can be no confusion about just what is the majority opinion on these details. Thoughts that are brought out can be readily compiled into a complete resume for the design department, and the engineer has positive knowledge of what his prospective customers want and can fill those desires to the greatest possible extent. No guesswork or "I hope they like it" here!

♦ ♦ ♦

Some companies may believe that their salesmen can reflect consumer thinking quite accurately. However, there is always the personal element to consider as the man making the survey may influence the replies of the person he is interviewing. An unsigned questionnaire, filled out in the solitude of office or home, can only reflect actual thoughts and desires.

♦ ♦ ♦

Designers are prone to blame the sales department when a creation does not sell as quickly as possible. A good habit to get into is the checking of all possible sales points in an effort directed toward helping the salesman sell. And one minor point which has a great deal to do with goodwill toward your company is the impression that is retained by visitors to the plant. Many a large, wealthy company has stiff, hard benches where visitors must wait much longer than what might be expected as the usual delay. Perhaps the visitors are salesmen, but you have salesmen too, and they may also be customers. Reception clerks, too, are often the cause of much lost goodwill. Have you checked recently?

♦ ♦ ♦

It is surprising how many valuable developments will bloom unsung for many years before they are brought to the attention of the world at large. As an example, we came across a new positive photoprinting process the other day, and it gives promise of being of especial benefit to design departments, yet very little has been told about it. The process is based on "Multazo" a positive reproduction paper for the copying of drawings, typewritten matter, etc., used in the same manner as blueprint paper with a shorter exposure time required. In exposure, the background is bleached out and the lines are colored by subsequent developing. The prints are developed dry.

♦ ♦ ♦

When discussing the field of MACHINE DESIGN, the editors have frequently stated that the articles cover all machines "from wrist watches to locomotives," both of which have been the subject of major articles. We thought that this classification was sufficiently broad, even though we have presented articles on smaller and larger machines. Now we have to revise our statement to "from wrist watches to telescopes" as the 200-inch telescope to be installed in California has been classed as the World's largest precision instrument. Truly a machine, the telescope will include unusual innovations. It is one of the most interesting designs of recent months.

♦ ♦ ♦

As we have often pointed out in these columns, one of the most creditable aims of design is the elimination of tedious labor. And one of the most tedious jobs is checking through millions of classified finger prints in an attempt to identify one particular marking. Now International Business Machines has developed a unit which operates automatically at the rate of 400 cards a minute to select from a master file of fingerprints those

(*Concluded on Page* 92)

You Need REEVES Speed Control to Insure

—THESE RESULTS ON THE MACHINES YOU DESIGN AND BUILD

1. PERFECT TIMING

A REEVES-controlled machine can be timed to a split second. It can be speeded up or slowed down to exactly the rate required for best results. Easy to meet changes in production schedules, differences in size, shape, composition or bulk of products, new sequences in processing, differences in number or skill of operators. Prevents waste of time and material.

2. ACCURACY

With REEVES speed control, you don't approximate the correct speed, you secure it *exactly;* and maintain it with absolute accuracy as long as desired. There is *no* slippage—and *no* fluctuation—at any speed, even under varying load. Positive and efficient transmission of power over the complete range required. Makes any machine a new instrument of precision

3. PROPER TENSION

In processes dealing with continuous flow of material—such as textiles or paper—from one machine or section to another, correct tension on material is indispensable. Through REEVES automatic control, exactly the proper tension is established and maintained—compensating for variances in type or moisture content of product, temperature, humidity, etc.

4. SYNCHRONIZATION

Through the use of REEVES Transmissions plus automatic control, related machines or sections of machines may be perfectly synchronized in speed to permit a smooth, continuous flow of material from one machine or section to the next. Entire production lines may be synchronized, yet easily and quickly varied in pace to meet changing production requirements.

5. DESIRED VOLUME

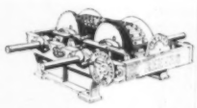
Maintaining volume—such as a fixed level of liquid in a tank—is another job for the REEVES Transmission. A float or pressure regulator is used to actuate Transmission, increasing or decreasing flow of liquid *into* the tank in direct proportion to amount of liquid taken *from* the tank. Similar regulating mechanism used with pumps, filling and capping processes, etc.

6. UNIFORMITY

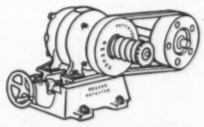
Uniform quality can be secured at a faster rate on a REEVES-regulated machine. Different shapes and sizes of products—different heating or cooling requirements—variances in moisture content, viscosity, density or hardness of raw materials—EACH of these variable factors can be offset by the correct, compensating change in speed. Simplifies product control.

It's the "variables" that cause trouble in manufacturing processes. These variables cannot be eliminated. But they can be controlled, as described above, when machines are equipped with REEVES variable speed units. Production men know this, and, in buying new equipment, show a decided preference for REEVES-regulated machines. Don't remain in doubt as to how speed control can be applied to the machines you build—or what it will accomplish. Ask REEVES engineers, and let us make a recommendation based on our experience in applying variable speed control as standard equipment on more than 1100 different makes of machines. A complete line of time-tested speed control units to choose from—insuring the correct size, design, type, speed ratio and control to meet your individual requirements.

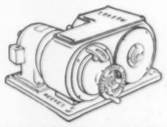
THE 3 BASIC REEVES UNITS



VARIABLE SPEED TRANSMISSION—for absolute accuracy over a wide range; fifteen sizes, fractional to 100 h. p., and speed variations from 2:1 to 16:1 inclusive.



VARI-SPEED MOTOR PULLEY—forms direct drive from motor to the driven machine. Seven sizes, from fractional to 7½ h. p. Provides speed variations over 3:1 range.



VARI-SPEED MOTO-DRIVE—combines motor, speed varying mechanism and reduction gears (where required). Horizontal and vertical; ¼ to 10 h. p.; speed variations 2:1 to 6:1.

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More Value per Dollar
More Simple Design
More Easy Installation
More Efficient
More Compact
More Attractive Appearance

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Bulletin 36-10 gives a complete description together with typical circuit applications, dimensions, capacities, etc. A copy will be sent to anyone interested.

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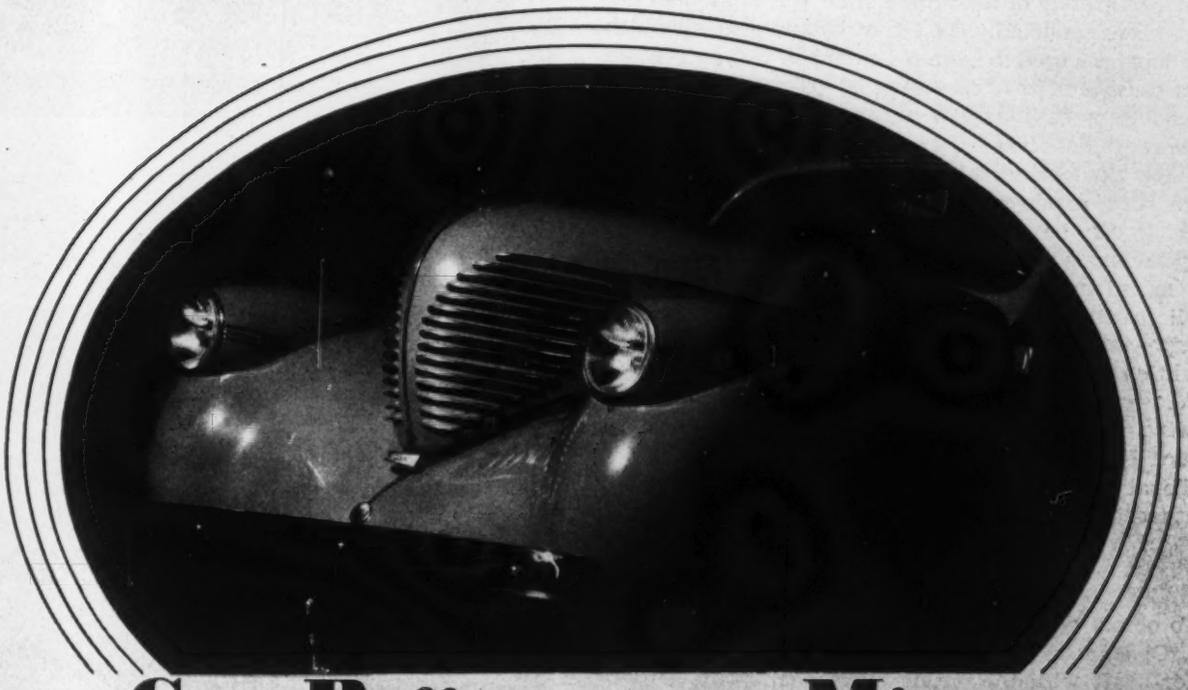
MACHINE DESIGN



Car Refinements Mirror Design Trends

By Austin M. Wolf
Consulting Automotive Engineer, New York

THOSE looking for radical changes in the 1937 automobiles will be disappointed, but the observer will find innumerable detailed improvements in chasses and bodies which now possess a new standard of safety, performance and style. Most of the improvements are found to react on the safety angle which has been uppermost in the manufacturer's mind. A comfortable driver's position lessens fatigue, clear vision minimizes some of the hazards of driving, better acceleration and braking gives superior control for emergencies, rigid frames assure more accurate and controlled response to the steering gear ratios, provid-

Fig. 1—Top of Page — Willys modernistic hood with integral grilles, and fenders with eyeball headlights, indicates type of prevalent body design

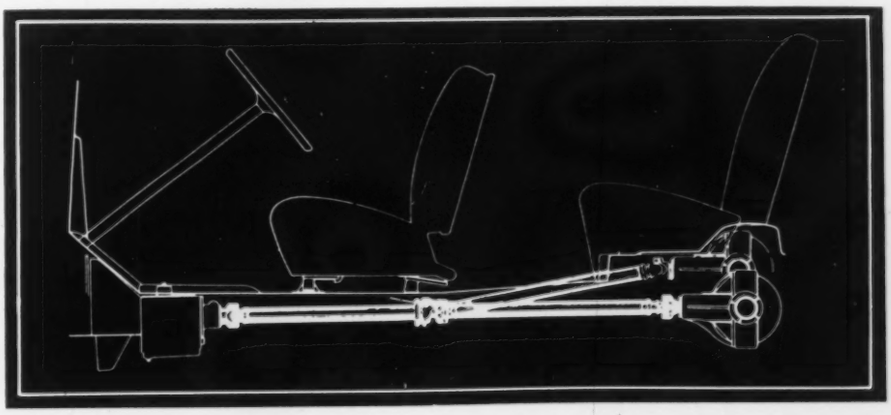


Fig. 2 — Left — Spiral bevel gearing permits elimination of propeller shaft tunnel. This design employs a two - piece, three - joint shaft

ing better control with lessened effort—these and numerous other measures making the new cars a distinct advance in design over what many considered a year ago to be well nigh perfection.

The lowering of floors from 2 to 3 inches and the center of gravity of the vehicle from 1 to 1½ inches has been made possible by the use of hypoid gearing which has only been used to a limited extent in the past. When it is considered that cars ranging from Chevrolet and Plymouth to Cadillac now use it, the indication is that price range has no bearing on its adoption. *Fig.* 7 shows the new Studebaker axle. Extreme pressure lubricants have been developed to a point where this type of gearing can be successfully used, but the servicing angle remains critical if different classes of lubricants are mixed or an improper lubricant is used. If the public can be educated to this effect and seek correct service, the manufacturers will cease worrying over a condition they themselves cannot control.

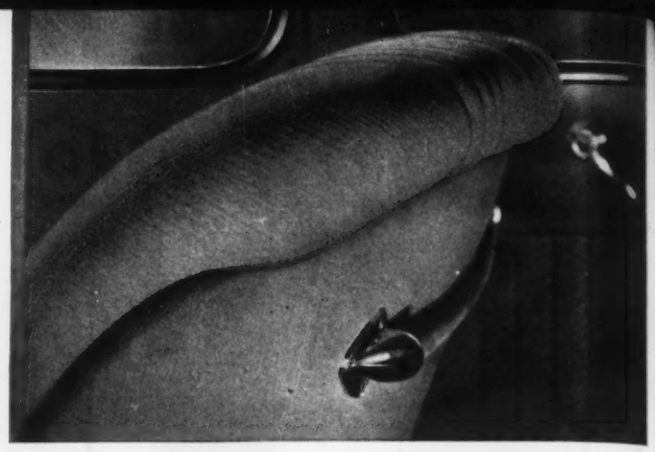
A lower spiral angle than is ordinarily used in hypoid gearing has been adopted by Buick and Cadillac to reduce bearing loads and insure better tooth contact while at the same time decreasing distortion during heat treatment.

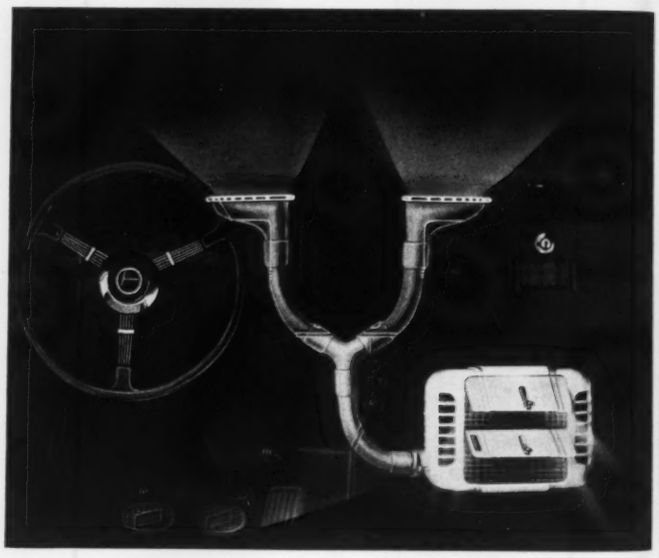
Propeller Shafts Are Jointed

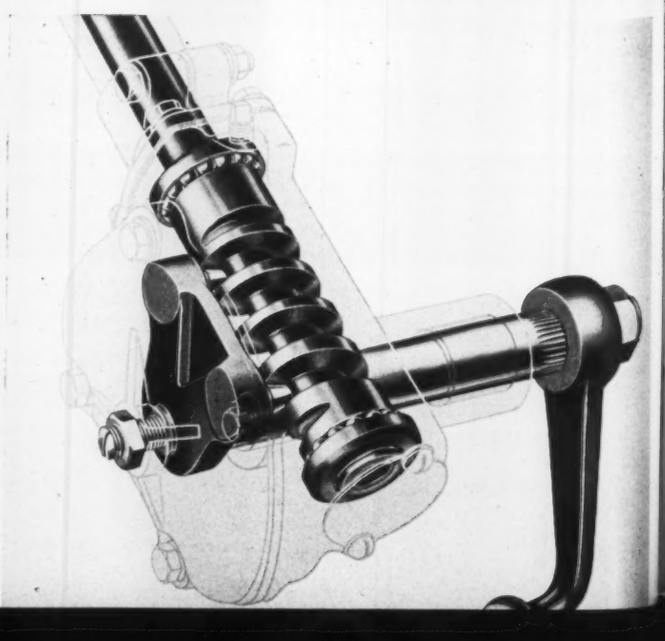
To obtain a low floor and still use spiral bevel gearing, Oldsmobile provides a two-piece three-joint propellor shaft with the center joint mounted in a position corresponding to below the back of the front seat, as shown in *Fig.* 2. The angular movement of the back portion of the rear seat causes only a slight central hump ahead of the seat. Pontiac provides a shortened two-joint propellor shaft by attaching an extension to the rear of the transmission enclosing a shaft provided with an external gear-tooth coupling mating with an internal member of the transmission shaft. This coupling acts as a slip joint to compensate for small misalignment as well as to take care of the sliding action required by rear spring movement. The extension shaft is supported by a bronze bushing on the rear of the extension which is protected by a slinger and felt seal. The coupling, bushing and speedometer drive are lubricated from the transmission.

A "nongenerated" spiral bevel ring gear is a departure from conventional practice since the ring gear tooth has no curvature in the normal plane but is of rack outline. Conjugate tooth action is secured by increasing the curvature of the pinion tooth in the normal plane on a universal type of hypoid pinion generator, and it is produced in the new Pontiac axle plant. Greater accuracy of tooth form and better surface finish are obtained.

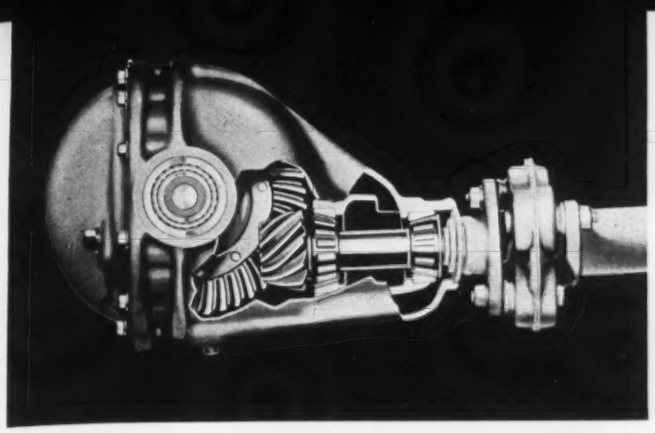
Changing the frame X-member from channel section to I-beam has increased frame rigidity as much as 400 per cent. This has provided a better foundation for the body as well as giving the car stability due to the im-

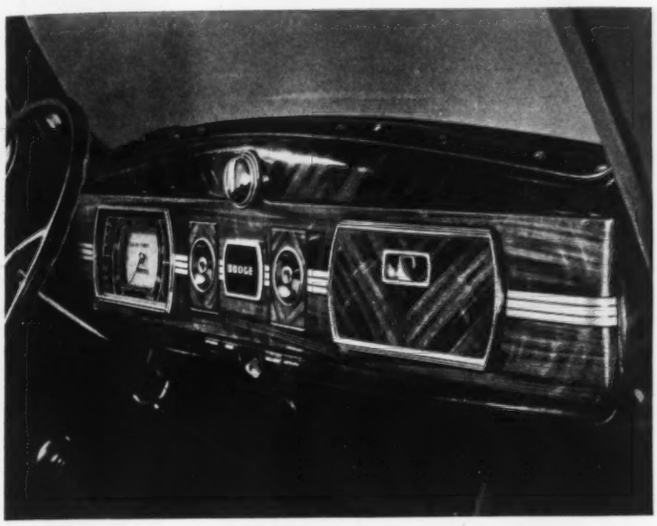


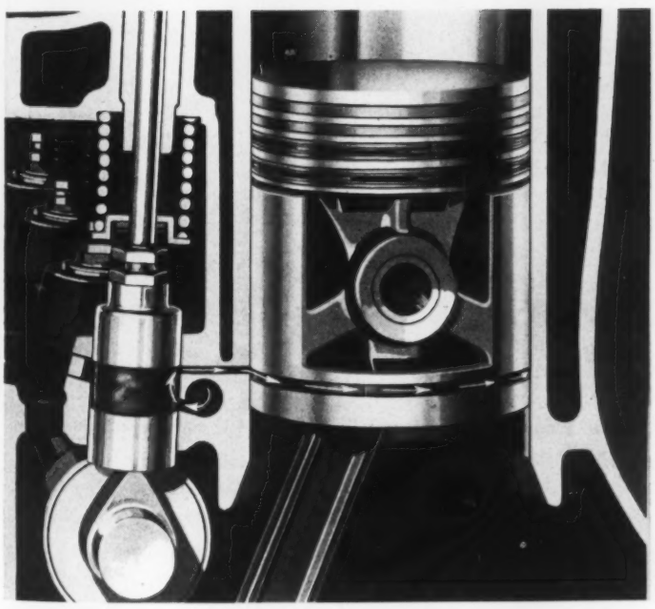


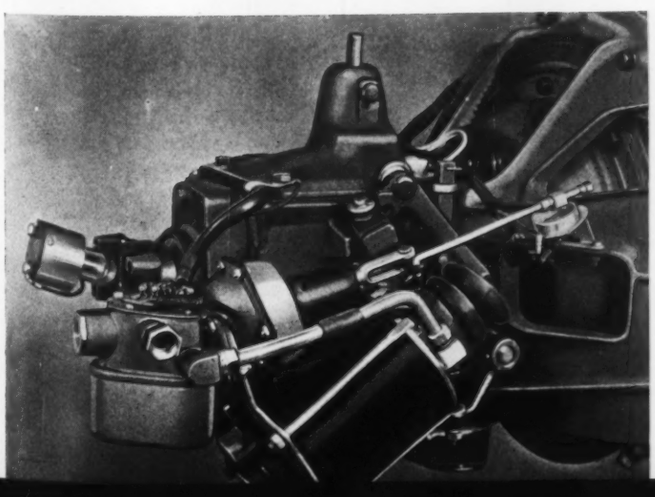


Top to bottom—Fig. 3—Top of seat back in Chrysler has a safety padding around the edge. Fig. 4—Safety door handles are used on all models. Fig. 5—The hot air windshield defroster has become standard practice. Fig. 6—Wear is reduced in steering gears by the employment of twin levers









proved rigidity for the suspension and steering systems. The I-beam is a built-up structure of rolled steel T-section, flash welded to flat stock blanked to shape and forming the web.

Considerable use is made in the new cars of a stabilizer consisting of a transverse spring steel bar journalled to the frame and with offset ends attaching to the axle pad, or to the lower control arm when individual wheel suspension replaces the front axle. Oldsmobile, Buick and Cadillac provide a stabilizer on each end of the chassis, one for each suspension.

The several cars built by Chrysler have a number of safety measures that are most creditable. The various controls on the instrument panel as well as the ignition switch key are recessed when in the operating position, thus avoiding any projections that might injure the occupant if inadvertently thrust forward. The Dodge panel shown in *Fig.* 8 shows the pull-type controls on each side of the switch-key where they are actually recessed under the face of the panel. Countersunk knobs are provided for the package compartment, ash tray and cigar lighter. Windshield wiper controls are of soft rubber and the opener is of the folding type and completely flush when not in use, replacing the former protruding crank. The top of the seat backs have a rolled edge extending across their width and incorporating padding and sponge rubber. Rigid robe rails are replaced by a silk cord as shown in *Fig.* 3. A reading lamp above the rear windows replaces the dome light to remove any ceiling protrusion. All cars are now provided with curved door handles as indicated in *Fig.* 4 to prevent the type of injury that has sometimes occurred in the past with straight pointed ends.

Defrosters Employ Extra Fan

Hot-air windshield defrosters are available on all cars which utilize a small centrifugal blower on top of the regular water heater unit to force a portion of the heated air against the bottom of the windshield on each side, usually through two flexible fabric ducts, as will be seen in *Fig.* 5. The regular heater fan is insufficient to force the air through the ducts and therefore a separate blower is used. When not defrosting, the air can be deflected to the floor to warm the feet of the front seat occupants.

The proper positioning of the driver for comfort and access to the controls is a vital safety measure. Most front seats have a 4-inch fore and aft travel and the seat back is tipped forward as the unit moves forward. The front seat-roller on each side is permanently located while the rear rollers operate on an inclined groove with approximately ¾-inch rise of the forward location over the rear. As the rear of the seat is raised in the forward movement, the seat-back tilts forward. In this way the driver is raised and a similar line of vision can be had by a short driver as by a tall one. Furthermore, as the seat moves upward at the rear,

Top to bottom—Fig. 7—Studebaker rear axle employs a rubber spool universal joint. Fig. 8—Dodge safety instrument panel has recessed controls. Fig. 9—Oil is led to the bottom of the piston in Graham cylinder. Fig. 10—Solenoid valve governor is at the rear, left, in this shifting unit

the feet are brought closer to and at a more comfortable angle with the pedals.

Greater ease in parking and better control at high speeds is obtained by the variable ratio provided by the Ross cam and twin lever steering gear seen in *Fig.* 6. In the normal position two pins engage the cam thread, doubling the strength and contact area of a single pin design. In the extreme positions only one pin engages. The variable ratio provided relieves the effort for parking and furnishes better controlability at high speeds.

Improved engine life and performance have been made possible by various measures. Ribbing is used in the cylinder block to prevent distortion of the cylinder bore, the valve seats and the block top deck, resulting from the heat of combustion or in drawing up on the cylinder head struts. Better shaping and relocation of the water holes in the head and top deck also help this situation. The "auto-thermic" silicon alloy piston is tin-plated to reduce friction when it is cold and when warmed up it will expand to a true circular form to any desired predetermined dimension under the control of a cast-in carbon steel strut in conjunction with an adjacent bridge member of the skirt forming a bimetallic unit at each side perpendicular to the wrist pin. Varying the relative amount and distribution of steel and aluminum gives any desired control.

Oil Flow Is Metered

In the Graham engine utilizing this type of piston a metered flow of oil is controlled by a circumferential relief in the valve tappet and led to a curve at the bottom of the piston as shown in *Fig.* 9. On the opposite side an air vent hole is drilled in the piston groove to insure flow of oil around it, particularly when the engine is cold.

The oil bath type of air cleaner is prevalent. There can be no question that the recent dust storms in the West have had an influence in their adoption. Fuel pumps whose bodies have been previously located near the exhaust manifold have been redesigned so that the bowl is below the operating lever actuated by the camshaft. This modification isolates the heat and permits the bowl to protrude beneath the engine pans into the outside airstream.

The use of flexible engine mountings, soft spring suspensions and low pressure tires have increased driving comfort but the reaction of the ensuing overall resiliency has often caused clutch clatter during engagement. This is now overcome by increasing the cushioning of the clutch driven plate. It invariably incorporates flat springs under the friction lining so that engagement will be gradual. Whereas a movement of 0.040-inch has been used in the past to compress the clutch plate from initial contact of the pressure plate to a full flat condition, this has now been increased to 0.060 inch minimum. It is now practice to hold the balance of the clutch plate assembly to within a limit of 0.3 ounce-inch.

Adopts Modified Overdrive

Studebaker is equipping its large model with a modified overdrive unit which can be cut in or out of action at any speed over 35 MPH. View *A* in *Fig.* 11 shows the overdrive pawls *a* and *b* in the overdrive positions. In view *A* the pawls *a* and *b* clear the inner member secured to the transmission shaft and engage the outer shell of the internal gear. In the direct drive position these pawls, under 35 MPH move inwardly in the slots and transfer the power directly from the transmission shaft to the rear shaft and universal joint. Assuming that the overdrive is in action, it can be cut out by shutting the throttle and the resultant coasting load causes pawl *d*, view *B*, to ride up on a stationary stud and lift itself from its mating slot in a member affixed to the sun gear, and which is locked stationary as shown in view *B* or made free if pawl *d* is clear of the slot as in view *C*. Should the engine be quickly accelerated the inward pressure of the spring on pawl *d* is insufficient to overcome the inertia of the oscillating member in which it is mounted and the slotted sun gear head will cam the pawl outwardly to a full released position. The drive is then taken through the roller clutch. Should the engine be accelerated gradually the oscillating assembly in following the rotation of the sun gear through the arc of oscillation will permit a full re-engagement of pawl *d* and re-establish the overdrive.

Terraplane and Hudson provide an automatic preselective shifting mechanism in which the previous "Electric Hand" layout is used in addition to an automatic vacuum clutch control which was popular a few years ago. It is, however, provided with a solenoid valve permitting disengagement of the clutch only when it is energized. A high gear locked switch is incorporated in the selector switch assembly under the steer-

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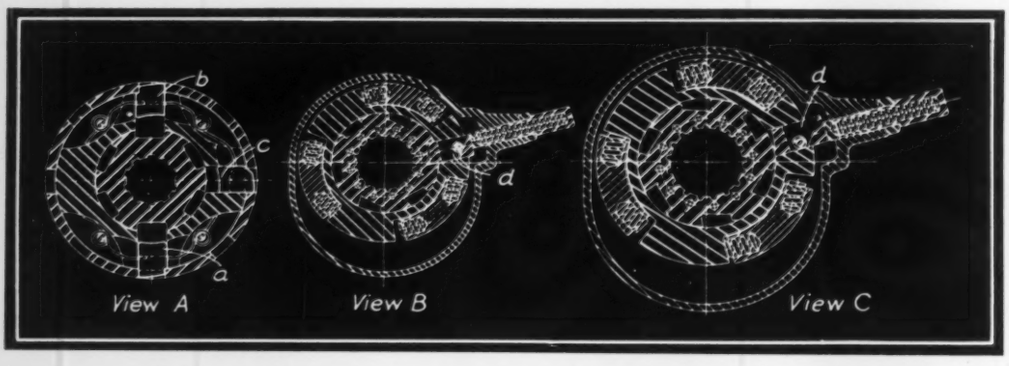

Fig. 11—Overdrive unit can be cut out by shutting the throttle, and coasting load will cause the pawl to clear its slot

SCANNING THE FIELD FOR IDEAS

INGENIOUS use of the oxyacetylene flame in the building up of composite bushings of bronze, babbitt and steel has been made in the machine shop of a large lumber company in the Northwest, according to the magazine *Oxy-Acetylene Tips*. The bushings are used in the connecting rods of mallet-type locomotives operated by the lumber company. They replace the solid cast bronze bushings originally furnished, those having been found to loosen up in the rods due to unavoidable pounding action in service.

The design of this composite bushing, as developed by the master mechanic of the company, is shown in *Fig.* 1. An idea of the size of the larger one will be given by the fact that it weighs 20 pounds. First, a steel shell, machined to exact dimensions for a tight pressed fit in the rod, is entirely coated inside with a flame-deposited layer of bronze welding rod material 3/16-inch thick. The ends of this steel shell likewise are completely faced with bronze, shoulders being built up toward the center of the bearing. These shoulders form a reservoir within the bore ¼ to 5/16-inch deep into which babbitt metal later is cast to form the actual bearing on the crank pin.

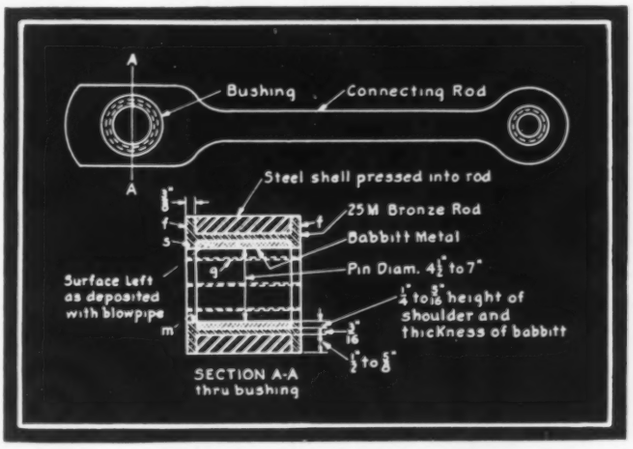

Fig. 1—Diagram of composite bushing which is built up with the help of a gas welding torch

Before casting the babbitt, the outer faces of the bronze shell (marked *f* in the illustration) and the edges of the shoulders (indicated by *m*) are accurately machined. A dummy crank pin, after being thoroughly coated with carbon black by means of the acetylene flame to prevent sticking, is then placed in position in the bushing and the babbitt is poured around it. The uneven surface purposely left on the bronze helps to anchor the babbitt in place, but cutting of six or seven thin grooves in the bottom of the shell to increase this locking effect, is recommended. After babbitting, the bushings are forced into the connecting rod under 16 tons pressure.

These tightly fitted steel shells do not pound loose in the rods and the walls of the bronze reservoir effectively prevent the babbitt from hammering out along the axis of the pin. Rebabbitting of the shell has been found to be a much easier, quicker and cheaper operation than either replacing all-bronze bushings or building up and reboring bronze bearing surfaces, refitting being necessary every two months regardless of which metal is used. Replacement of twelve bushings formerly kept a locomotive in the shop for two days, but with the composite bushings the replacement is now accomplished in half a day.

SIMPLE DEVICE GOVERNS AUTOMOBILE

GOVERNING of automotive engines by a universal device which can be adjusted to provide the same accurate governing characteristics at all speeds and without affecting power, response, acceleration or fuel economy has been a problem. This is said to be solved

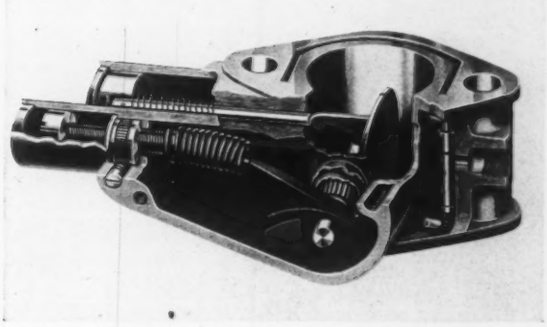

Fig. 2—Velocity and vacuum forces acting on a throttle plate actuate this governor

by the Vari-Speed governor shown in section in *Fig.* 2.

This unit was developed to do away with the necessity for several types of governors when different vehicles in a fleet must be regulated for different speeds. The unit shown can be set for top speeds between sixteen and sixty miles per hour. It is "non-stealing," that is, it cannot be made to vary by manipulation of the throttle or other controls.

The main details are a valve, a cam and a spring and a throttle shaft carried on needle bearings. A throttle plate supplies the operating power. Spring and the cam are linked together so that velocity and vacuum forces are properly balanced. Adjustment not only changed the effective length of this spring but also alters its characteristics, thereby making it equivalent to an infinite number of springs.

The mechanism is housed in a one-piece casing with cover riveted on to prevent tampering. Adjustments can be of sealed type, simple locked type or remote control to dashboard with lock.

BELLOWS SEALS STAND HARD SERVICE

TO KEEP lubricant in and grit and water out of the final drive of a tractor is more difficult than in the case of almost any other machine. Being built primarily for operation where there is no road or over roads of the worst kind, a tractor is often called upon to wallow in deep mire of plowed soil, sand, gravel, mud, water or snow day after day as a part of its routine service.

Chain treads or tracks are made of hard, tough materials rather loosely fitted so that mud does not affect their operation, but at the point where the final drive comes to the sprocket, precision begins and at that point foreign matter definitely must be excluded. The manner in which this is now accomplished on Caterpillar tractors is shown in *Fig.* 3, the main view being of the final drive in partial section. The elements which seal the lubricant in and dirt and water out of the housing of this final drive in spite of unavoidable deflections in the mechanism, are specially designed copper bellows seals. One of these is located at each side of the sprocket hub, bearing against smooth, hardened, corrosion-resisting washers fitted on each side of the track sprocket. Flat sealing surfaces of the bellows seals are pressed against these washers by a series of coil springs inside the bellows. These springs show clearly in the enlarged view of the bellows in the upper righthand corner of the cut.

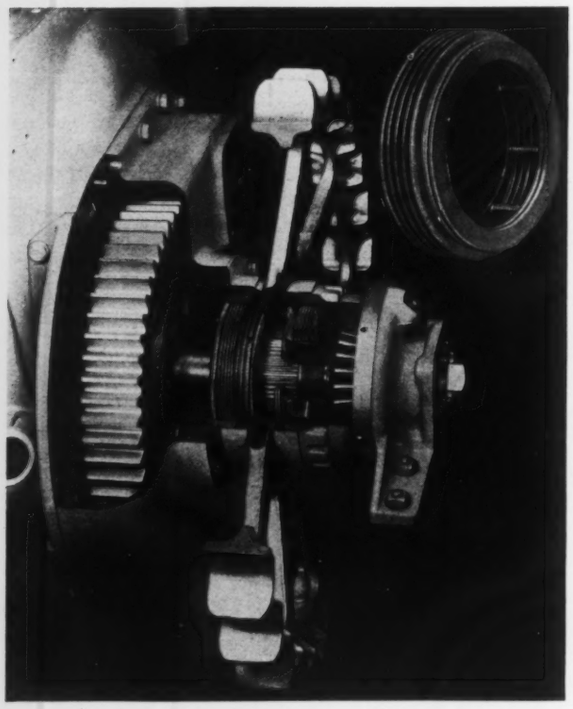

Fig. 3—Copper bellows seals keep oil in and dirt out of final drive cases of tractors

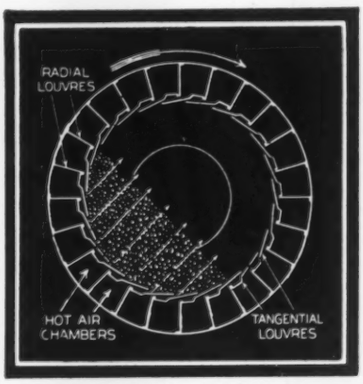

Fig. 4—Tangential louvres admit air but retain material

Oil inside the bellows lubricates the rubbing surfaces at the same time slowly seeping outward between the surfaces, thereby constantly carrying the dirt away from the outer edges. The seals are designed to be self-adjusting to all kinds of deflections to which the mechanism is subjected under rough operating conditions. As the effective sealing in this case does not depend upon heavy pressure between bearing surfaces no power is wasted and what little wear there may be is taken up automatically.

This method of sealing is so effective that it has been found necessary to vent the gear cases of these final drives in order to take care of expansion and contraction of the air within the cases as the temperature changes. Under operating conditions it is necessary to change the oil in the final drive only at 900-hour intervals.

KILN PROVIDES FREE AIR FLOW

IN DESIGNING rotary cylinder kilns for drying coal, grain, coffee and other loose materials which flow readily, one problem is to provide means of passing hot air through the material which will not at the same time allow the material to escape into the air channels.

There has been developed in England, and now is manufactured in the United States by the Link-Belt Co., a rotary dryer which is said to solve the problem

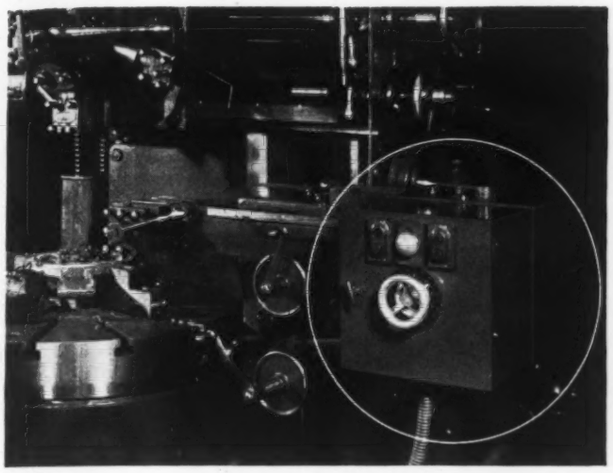

Fig. 5—Electrical control located at operating position combines pushbuttons and rheostat in a single housing

through a unique louvre system. A diagrammatic cross section of this dryer, as seen from the front end, is shown in *Fig.* 4. The receiving end of the drum is sealed by a stationary head which has flanged connections for the air duct and feed-in hopper. This head has air passages so placed as to register only with those longitudinal air channels in the revolving drum which lie immediately underneath the material as the drum revolves. The effect of this arrangement is brought out by the indicated air flow in the illustration.

The segmental air channels in the inner periphery of the drum are covered by tangential plates or louvres which overlap like loose shingles so as to leave gaps for the air to pass freely into the material but which at the same time prevent any of the material from falling back into the air channels. The channels taper in depth from front to rear of the drum, thereby giving a slope to the inside which causes the material to flow gradually from front to rear as the drum rotates.

UNIT GIVES CENTRAL CONTROL

COMBINATION of pushbutton stations and rheostat control in one compact case suitable for mounting at the operating point of a machine is provided in a unit developed by the Electric Controller & Mfg. Co.

One of these units is shown in *Fig.* 5, mounted on the side of a vertical turret lathe in close proximity with the mechanical controls and within easy reach of the operator. This unit embodies "Fast—Slow," "Stop," and "Start—Jog" control, pushbuttons being mounted on the door of the cabinet adjacent to the operating wheel of the rheostat.

The rheostat itself is of ball bearing type and is mounted on the back of the cabinet. Its handwheel which is on the door is designed with a tongue and groove arrangement so that the door can be closed only when this wheel is properly aligned with the operating arm of the rheostat. This insures that the setting of the rheostat when the door is closed actually corresponds with what is indicated on the dial plate surrounding the operating wheel on the outside of the door.

Rheostat units of this general type are now being applied to various kinds of machines which for maximum efficiency require concentration of control at the strategic operating point.

GAS POWER FOR ELECTRIC TRUCKS

AN EXAMPLE of design involving installation of considerable machinery in a decidedly limited space is given by gas-electric power units which replace storage batteries on electrically driven industrial trucks. One of these units, built by the Ready-Power Co., is shown in *Fig.* 6, together with a view of its application on a heavy duty Elwell-Parker truck for handling coils of strip steel.

The water-cooled engine is of automotive type and is mounted on rubber supports on a pressed steel subframe. It is direct connected to a six pole, compound wound generator whose armature takes the place of the flywheel. This armature is bolted to the flange of the crankshaft. There is no armature shaft or outboard bearing. Its series windings are on soft iron laminations supported on a light malleable iron core. This core has cast fan blades at front and back which force air over the end turns of the coils.

Engine speed, generated voltage and consequently the speed of the truck are under electric governor control. Normal speed is 900 revolutions per minute for rated voltage and load but it can safely be stepped up to 1250 under peak loads. The governor provides automatic idling which means that engine speed is reduced for economy when no power is used. As power is required the throttle opens automatically, voltage builds up gradually and smooth starting results.

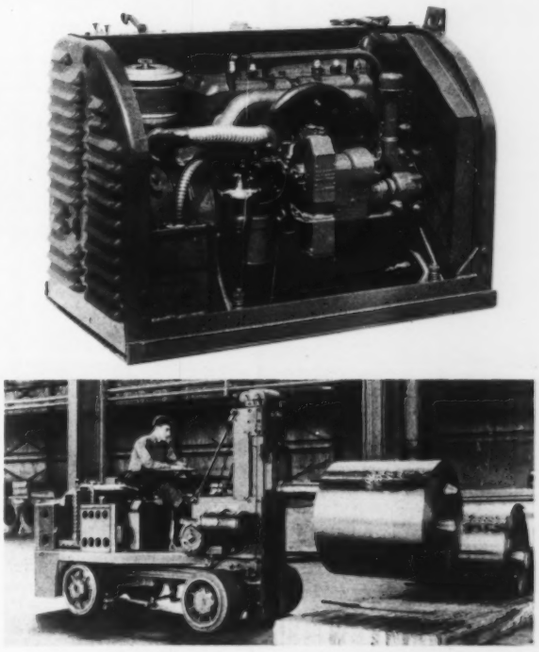

Fig. 6—Designed for compactness, this engine-generator set fits battery space on truck

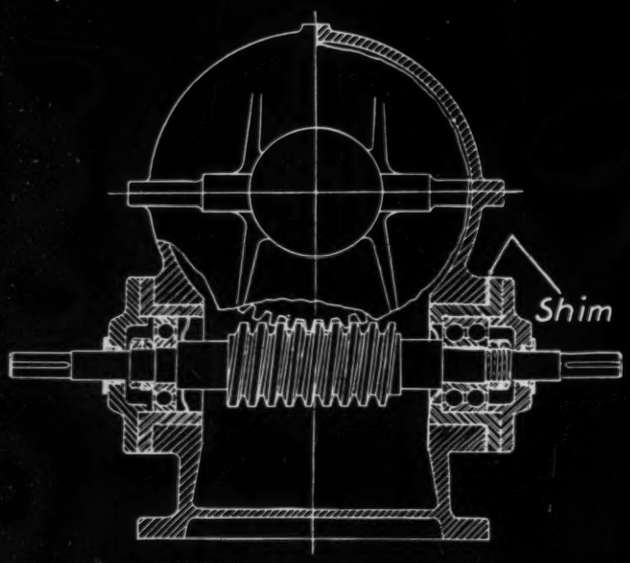

Fig. 1—Adjustable shims accurately position the worm by fixing the location of the bearing holder

SHIMS OF VARIABI H

PRECIS D

DESIGNERS who think of shims merely as a convenient means of split bearing adjustment have overlooked numerous other applications of equal utility. Wherever a degree of adjustability is desired between mating parts which are fastened together, the laminated shim is deserving of consideration. Such shims are most convenient and satisfactory when made from thin sheets bonded over the entire surface. This construction excludes dirt and foreign matter and avoids yielding between layers. Laminations are usually 0.002 to 0.003 inch thick. They are made to peel readily and provide smooth and flat surfaces, no matter how many laminations are peeled off. Recent developments include special types of laminated shims with a solid babbitt edge to prevent oil leakage from split bearings.

Fig. 2—Exact fit, another important design point, is determined by the spacing which can be adjusted when assembling this cap

With laminated shims it is a simple matter to make service adjustments. But of equal or perhaps even greater importance is the ease with which correct adjustments are made in original assembly. This includes the ready alignment of various parts without wasting time in such slow processes as filing or grinding mating surfaces. By the use of laminated shims it is possible, for example, to control the meshing of gears to the optimum depth. It is easy also to position antifriction, thrust and other bearings positively and correctly, or to align the parts of an assembly to compensate for inaccuracies in machining.

The laminated shims, in short, makes possible an accurately controlled variation in thickness, quickly changed with no other tool than a knife used in peeling laminations, and also provides for later adjustment in the event of wear. Examination of the accompanying illustrations of specific applications, furnished by cour-

Fig. 3—Scores of different sizes and shapes of adjustable shims, some with a babbitt edge dovetailed into the laminated portion, have been produced. Thickness is changed by peeling with a knife

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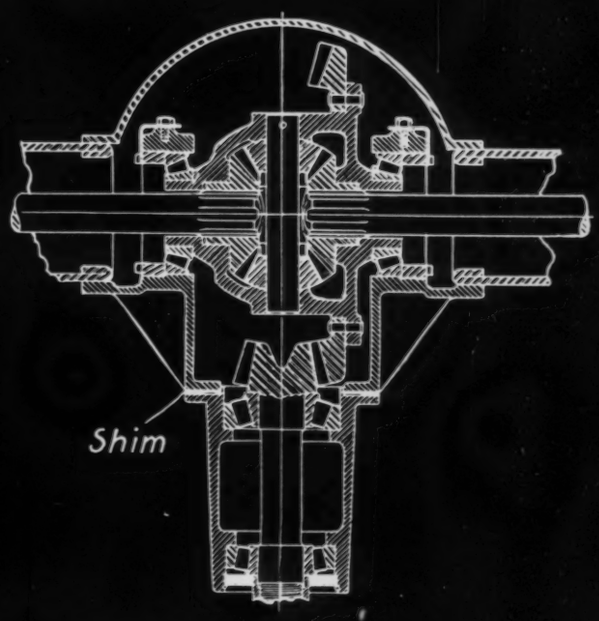


Fig. 4—Mesh of the bevel pinion with the ring gear shown is controlled by the thickness of the shim

tesy of the Laminated Shim Company Inc., makes these points quite evident.

In *Fig.* 1 there is shown a method of applying a laminated shim for controlling the axial position of a double-row radial and thrust bearing of the ball type. This, in turn, fixes the worm in reference to the casing and to the worm wheel. Such positioning is an important consideration in an assembly of this kind and is readily met by using the shim in the position shown in the drawing.

Fig. 4 shows an automotive application in which a laminated shim controls the meshing of a bevel pinion with a ring gear. As will be seen, the shim is placed between the pinion carrier and the ring gear housing. Such applications afford a positive positioning and also tend to promote quietness in operation by eliminating incorrect meshing. Similar applications are equally useful for controlling the mesh of bevel gears in other machines. In the instance shown, the thrust is away from the shim. The latter is so located that the removal of a shim puts the gears further into mesh.

When it is desired to control the fit of a split hub on a square (or round) sliding shaft, a convenient and inexpensive method is to apply laminated shims as shown in *Fig.* 2, illustrating part of a bread slicing machine. If wear occurs in the gearing (hub) or shaft, adjustment is quickly made by peeling a lamination from the shims. Initial adjustment is, of course, made in the same way.

Provide Ways Adjustment

In *Fig.* 6, which shows the bed and hanger of a Miller printing press (in inverted position), laminated shims are employed for convenient adjustment of ways

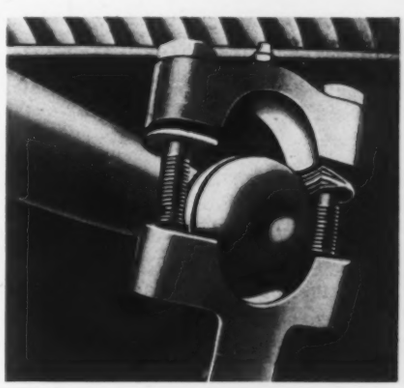


Fig. 5—Variable thickness shims employed for adjustment of fit in ball and socket joints at the ends of lifting links

at *A* and under the racks at *B*. In the latter instance the shims control the mesh of the racks with the mating pinions. Laminated shims are often employed for adjusting ways on different types of machines. They afford a convenient means of setting the ways for proper clearance with the sliding member in the initial setup of the machine and also give a ready means for service adjustment after wear takes place. In some instances such construction does away with

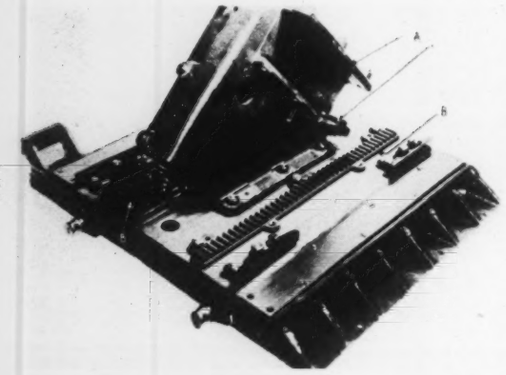


Fig. 6—Laminated shims are used at the ways and racks in printing press bed and hanger

the need for adjustable gibs which are much more expensive.

The most common application of laminated shims is in ordinary split bearings, as in connecting-rod big ends and in pillow blocks. But the shims are effectively employed singly, rather than in pairs, in slotted bushings. Such a use is made in the connecting link of a slicing machine, made by the Micro Machine Co. By removing a shim, peeling a lamination, replacing the shim and tightening a bolt on the split end of the link, a slotted bushing is closed in a small amount, effecting the required adjustment.

Laminated shims are sometimes employed advantageously for adjusting the clearance between the ball and socket of ball joints, as in the lift links for the Adams road grader, *Fig.* 5. In this, as in many other cases, both the initial adjustment and subsequent service adjustments are easily made. Filing, grinding or the carrying of several thicknesses of solid shims would be necessary otherwise, unless a more expensive screw adjustment were employed. In addition, with laminated shims available in almost any size, shape and thickness, there are many cases in which their use makes it unnecessary to hold close tolerances in machining. This naturally tends to decrease the cost of machining.

Shim Locate Antifriction Bearings

Another important use of laminated shims is in the adjustment or the preloading or both, of antifriction bearings. In such cases a high degree of accuracy can be secured by using shim laminations of known thickness. Here again the shim can be employed to abet the accuracy of machine work, especially where a long shaft makes it difficult to hold the required limits on bearing spacing. Also, in antifriction bearings which are subject to wear the required adjustments are easily restored by removing one or more laminations from the shim after wear has taken place. In *Fig.* 7 is shown a Monarch lathe application in which service as well as initial adjustments of antifriction bearings are provided by using laminated shims.

In bearings having forced feed lubrication the use of laminated shims with solid babbitt inner edges solves the problem of sealing the bearing and thus maintaining the required oil pressure. This form of shim has made it unnecessary to redesign bearings in many instances when a change to pressure lubrication was made. In such shims the babbitt portion dovetails into the laminated section. As the babbitt is quite soft it is readily fitted to give whatever clearance with mating parts may be required and still allow for bearing adjustment as it becomes necessary.

Gives Accurate Alignment

Aside from the various uses already outlined, laminated shims are often used with marked advantage in alignment work. This applies to such operations as the exact adjustment of shaft height and to leveling in bringing an electric motor or other driving

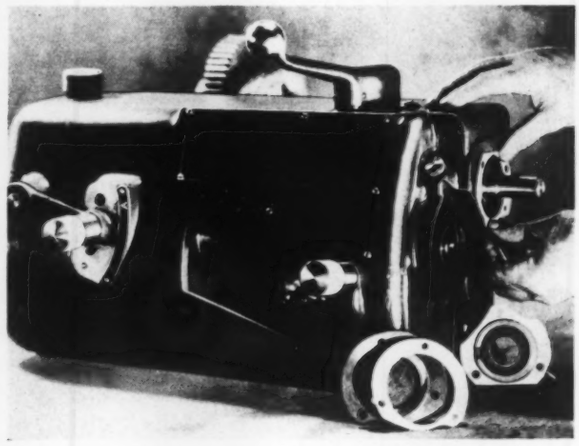
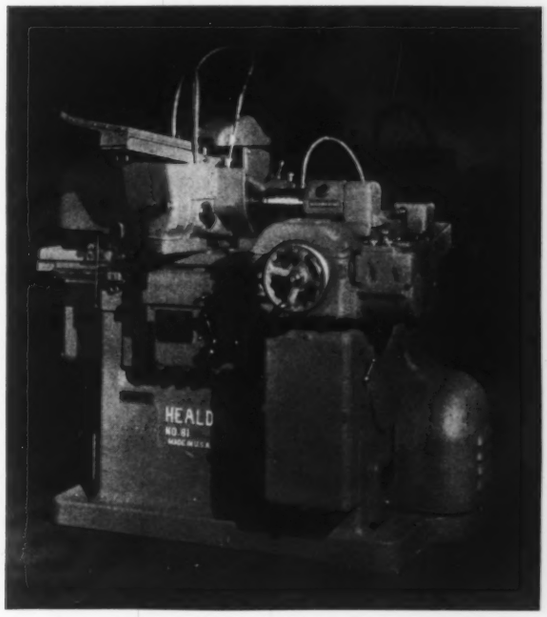


Fig. 7—Lathe gear box shows how adjustable shims are employed for precise positioning of bearings

unit into correct alignment with a driven machine. If solid shims are employed a tedious and expensive job of alignment is likely to result, but if the shims are laminated the required adjustments are quickly and inexpensively effected. Much the same applies in joining the frame or separate bedplates in some machines or in fastening together the units of machines built up by multiplication of standard units to form complete machines of varying size.

Further specific applications might be cited, but those already mentioned serve to show the wide range of uses which have been found for laminated shims. The uses described may well suggest others in which such shims might be employed with equal advantage.



APPEARANCE . . . . In designing guards for numerous functional parts of this grinder, good looks as well as safety have been attained

What About Machine Tool Design?

By Guy Hubbard

THIS brief survey of the machine tool design situation, the first of a series covering several important branches of industry, is based on conversations during recent months with representative designers, builders, dealers and users. Among other things the survey emphasizes desirability of thorough study of users' requirements, prior to launching an important design project. This point applies with equal force in many other industries.

WHEN an engineering investigator seeks comments on the question "What about machine tool design?", his eventual impression is apt to be that builders, sellers and users of machine tools all have different ideas as to what constitutes good design. In contemplating the situation there comes to mind this description of a doughnut, "You take a hole and put some dough around it." Getting back to first principals, is not the problem of designing a machine tool something like that? In other words, "You take a job (such as boring a hole) and build a machine around it." A machine tool is after all only a means to an end, the end being the rapid and accurate machining of pieces of various shapes and sizes within the capacity of the machine.

If there is any one opinion that is general among builders of machine tools today, it is to the effect that to an increasing degree, " . . . . every machine is a special machine." On the other hand, many users of machine tools say. "In these days of quick shifts in public preference as well as in manufacturing methods we never know when we will have to make drastic changes in what we make and in the methods of making it. We want versatile production machines which can be converted quickly and cheaply to uses other than those for which they were originally purchased."

Some authorities consider that the rising tide of special designs was a result of the depression when in a desperate effort to land an order a machine tool builder would allow his sales department to talk him into designing something special for a customer, the idea being that if the initial machine proved successful many more of the same kind would later be purchased. Unfortunately, most of those subsequent orders never

materialized. Had the builder spent an equivalent amount of money in redesigning his standard machines to have greater range and flexibility, and in designing a more complete line of attachments and tools for them, much of this special machinery building undoubtedly could have been avoided. While the co-operation of salesmen and servicemen with the engineering department of a machine tool plant is of very great value in keeping design in step with the times, care must be taken that the enthusiasm of the sales force does not sweep the company into unwarranted projects.

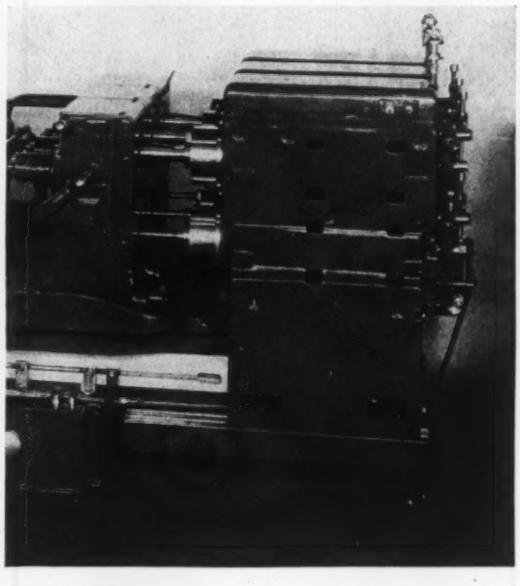
Completeness or Complication?

Most modern machine tools are of far more involved design than were their forerunners of a few years ago. User opinion on this condition is mixed. What to the builder is "completeness," is—to some users at least—"complication." "Where," said one user, "can I get a lathe of very high quality which at the same time is a lathe reduced to its simplest form?" This man evidently had fine work of rather simple character which did not require the use of many of the refinements included as standard equipment of the modern engine lathe of the better class, but at the same time he did need the refinements in the basic quality of the machine. As he put it, "I must have a first-class machine, but I don't like to have to pay for all those gadgets that are of no use on my work."

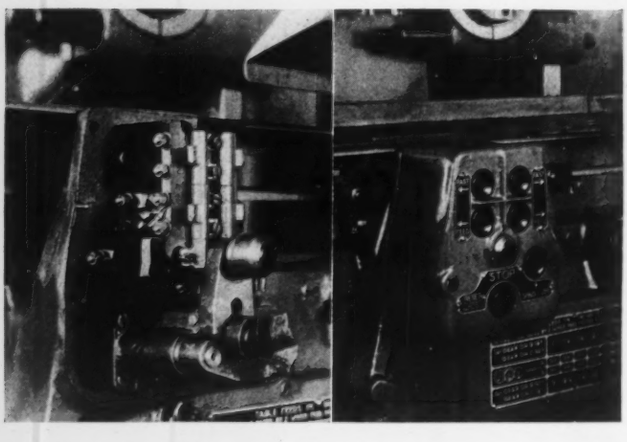
Unquestionably there are simple lathes which at the same time are good lathes. He had his mind set, however, on a certain make of lathe which in its standard form is a marvel of completeness. While a simple basic machine can be designed for the economical application of attachments of various kinds, the stripping of a machine of built-in refinements usually is not an equally economical procedure. Unless the majority of users need the majority of the refinements, serious attention should be given to designing these refinements as extra attachments rather than as built-in details of the machine. What is good practice for one builder may not be good practice for another. Here is an instance where the engineering department needs the help of a careful market survey, not simply the reaction of one man or one user company.

When a company does design a basic standard machine for which a wide line of attachments is to be available, it is highly important that the design of the attachments be considered carefully along with the design of the machine itself. Above all it should be made certain that all surfaces to which standard attachments may be applied are not only accurately finished but also accurately drilled and tapped to accommodate the attachments if and when a user eventually has to apply them.

The degree of interchangeability of standard machine tool parts is infinitely higher than it was twenty years ago, but too many attachments still go out which have to be tediously "fitted on." Most of them were afterthoughts, hence provision for them was not made in the original design. The average customer's shop is a mighty poor place to do fitting of that kind. Furthermore, work of that nature in a customer's shop is bad publicity for the machine tool builder. It does to a machine tool company what too many roadside repairs did to some of the early automobile companies. Forethought in the engineering department forestalls that kind of thing.



VERSATILITY . . . . Standard carriage and head blocks allow removable mounting of special fixtures and boring heads



ELECTRIFICATION . . . . This milling machine control is a result of co-operative mechanical and electrical engineering development

This brings out another thought which is, "Avoid using your customer's plant as your experimental department." A machine tool so well designed that it does not in its original form contain some "bugs" is rare if not a miracle. Naturally, the better the engineering, the fewer the "bugs," and machine tool engineering today generally is of a high order. At the same time, a high percentage of invention is involved in new machine tools and in many cases this must be carried out under pressure for delivery which is inclined to get new machine into the customer's plant even before the maker knows how it will perform.

This by-passing of a suitable running test in the builder's shop is a dangerous practice and is unfair to the engineering department as well as to the customer. Many a 98 per cent perfect design has been roundly condemned because some slight adjustment was not made to the new machine before shipment, or even because of some shop error for which design was in no way to blame.

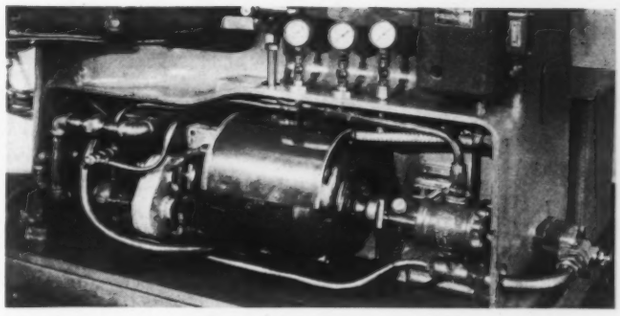
Production machines are moved about much more frequently than they used to be. In automobile plants, for instance, it is not all unusual for sweeping rearrangements of equipment to be made every year as production of new cars is planned. Not only are they moved more frequently, but also they are moved in a different way than of old. Some machine tool builders have recognized this condition and have made in their designs convenient and safe provisions for the lifting and spotting of their machines by the use of cranes. Strong eyebolts are provided at points of balance, not only on the machines but also on the heavier attachments. Projections such as reservoirs which by their nature invite use as points of attachment for hooks and slings are made heavy enough to stand such use. Study by a designer of the rough and ready handling which a machine receives in a user's plant is valuable insurance against incorporation of weak members which invite rough use in handling.

Make Machines Fit Men

Machine tools generally are becoming much more convenient to operate. Common sense rather than application of any deep theory has been responsible for much of this improvement. In the case of one signally convenient line of machines, here is how this end was accomplished. When one of these machines was on the drafting board every effort was made to group the control levers at a strategic operating point and to design them for easy and safe operation. The machine was even laid out full size on a vertical board and the location of the controls checked against operators. "Fitting the machine to the man" did not end with that, however. When the machine was built, it was equipped with temporary control handles which could be bent and otherwise altered. Up to these controls stepped not one but a number of practical operators, and the bending and changing was continued until the majority were satisfied with the location and "feel" of the handles.

Then—and not until then—were the final handles designed, these permanent handles being laid out from the revamped temporary ones. Acceptance of these machines by users has amply justified the trouble and expense of this "tailoring-to-fit," which after all was not a very costly procedure. It also should be mentioned that attention was paid at the same time to convenience of tooling, of inserting and removing work, of lubrication and of operating safety. Practical suggestions by the "guest operators" led to several design changes in those respects.

While on this subject of control, a word is in order regarding electrification installations. The importance



ACCESSIBILITY . . . . Removable housing provides for convenient adjustment or repair of "built-in" hydraulic operating and control unit

of this is attested by the fact that large manufacturers of electrical equipment not only are making special efforts to provide drive and control elements especially suited to machine tool service, but also are doing a great deal to educate designers of metalworking machinery in the fundamentals of safety and efficient electrification. It is plainly evident that machine tool electrification has developed beyond the point where it can be handled casually by any draftsman with the help possibly of one of the electrical maintenance men from the shop. Several machine tool builders lately have demonstrated in new machines what competent electrical engineers can do in co-operation with competent machine tool designers. It is obvious that the electrical machine tool engineer today has a definite place along with the machine designer and the tool engineer in the engineering department of any progressive machine tool plant.

New Sizes Involve New Problems

Much has been said lately about the sweeping changes which have taken place in machine tool design since 1929. One point that has escaped general notice, however, is the engineering problem now facing many companies—the problem of carrying the changes throughout an entire line of machinery, uniformity being desirable to identify the line. In most cases the so-called sweeping changes were made in one size of one kind of machine, and for the sake of economy it frequently has been one of the smaller machines. The idea has been of course to develop and perfect the new ideas in this one machine and then swing the rest of the line swiftly over to the new design.

Managerial executives in a plant are inclined to think that once the small machine is perfected, all that is necessary to bring out equally successful large machines is simply to increase the sizes of parts. Unfortunately for the peace of mind of the engineering department, it is by no means as simple as that, because as a machine grows larger its physical characteristics change in unexpected ways and it becomes to a large degree an entirely new design problem. Unless this is realized, the engineering department either will be accused of undue slowness, or will bring out dubious designs as a result of undue haste.

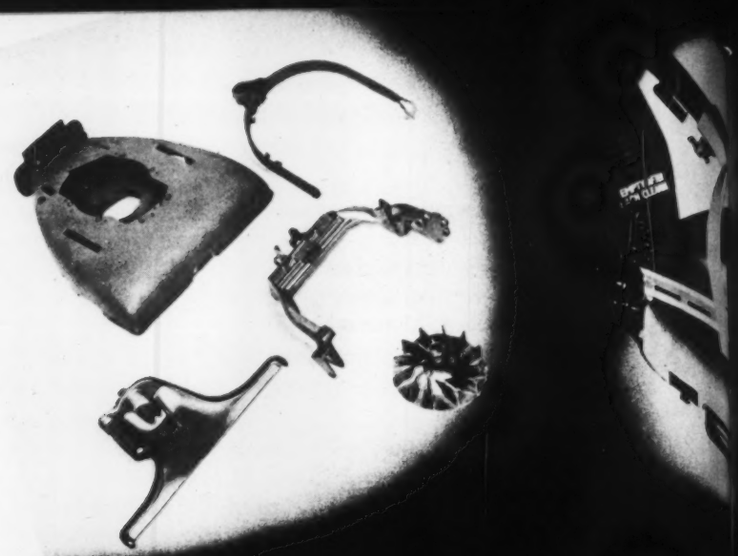


Fig. 1—Lightweight metals to the fore! Five magnesium parts used in cleaner shown in center

Don't Limi N by Sticking t

By U. A
Hoov

IN DEVELOPING a new model of almost any machine the designer usually is limited due to the fact that the time allowed and the tooling appropriations permit only a modification of the last previous model rather than a complete redesign. In new models, whatever the machine may be, it will probably be found that less than 25 per cent of the parts or materials are new. This naturally confines the possible changes in design to a comparatively small portion of the machine assembly. An even more serious limitation, however, is caused by the fact that such newly designed parts must be made to fit into the work with the remaining 75 per cent of old parts, which results in a compromise as to features, materials and appearance.

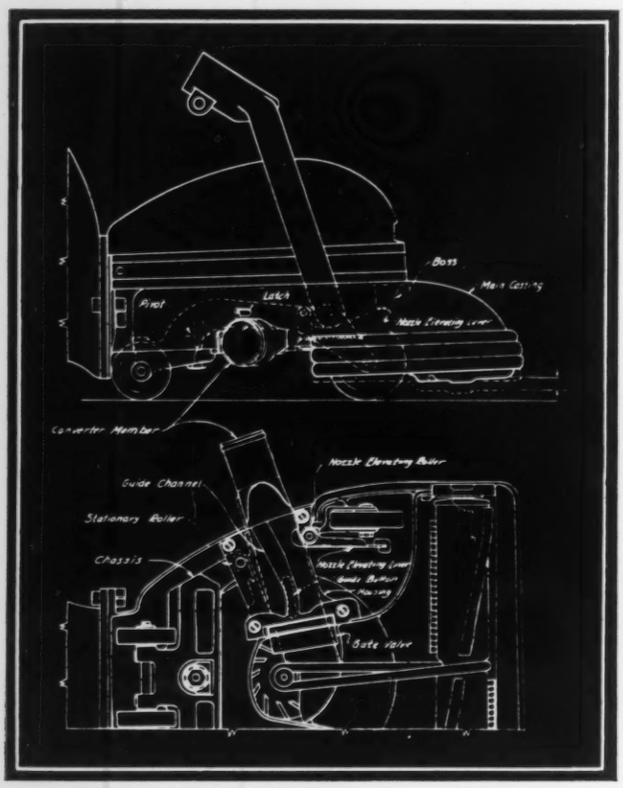


Fig. 4—Conversion mechanism changes cleaner automatically from floor-cleaning to cleaning-tool operation

No Compromise Necessary

When the Hoover engineering department was given the assignment for the Model 150 cleaner shown in *Fig.* 2 no such limitation was made, it being agreed from the start that this was to be an entirely new machine throughout and that there should be no limitation as to time or tooling expense. Consequently, of the 360 parts in the machine over 250 are new and the remaining parts are minor items such as screws, rivets, etc. The tooling and equipment expense was high but the result is a machine having many new and useful features, better performance, and decreased weight. Complete freedom of design has permitted the use of new materials which otherwise could not have been used at all, or at least only to a limited extent.

In planning the design of this machine it was agreed that many features previously excluded due to the dif-

Fig. 3—Phenolic plastics also have their place, even the motor frame and end plate being molded

ficulty of incorporating them in the old design should be adopted. Several of the more interesting of these design features will be discussed later in this contribution.

Heretofore the cleaning tools supplied with an electric cleaner were generally used only a few times and then stored in the attic to be forgotten. This was due mainly to the inconvenience in converting the cleaner from floor-cleaning to cleaning-tool operation—not a particularly difficult procedure but one too complicated for the average housewife. One of the requirements of the new cleaner, therefore, was a convenient means by which the unit could be converted from floor-cleaning to cleaning-tool operation.

This was accomplished in a simple manner as shown in *Fig.* 4. Like most of such mechanisms, the earlier designs were much more complicated, but final refinement produced the mechanism shown. The conversion operation is primarily that of closing off the air passage from the nozzle to the fan chamber and simultaneously establishing a connection between the cleaning tool hose and the fan chamber. A readily accessible port or passage at one side of the cleaner casing is provided for insertion of the converter member (shown in both views). Insertion can be made either with the cleaner idle or running and, in addition to effecting conversion, causes the nozzle and agitator to be lifted from the surface covering, thus eliminating any drag which would tend to decrease motor speed and so affect suction.

As clearly shown in the drawing, the port or passage into which the converter member is inserted leads inwardly from the side of the cleaner casing and communicates with the main air passage through a hinged flap valve which normally is closed. The metal plate or housing forming the under side of this passage is provided with a U-shaped channel and a stationary roller for guiding the converter member into place. When insertion is made, the guide channel engages the guide button on the under side of the converter member and acts to prevent interference of this member with the fan hub, while the stationary roller contacts a wedge-shaped projection on one side of the converter member which causes the member to move forward with respect to the nozzle while moving inward with respect to the fan eye. The horizontal forward movement thus imparted to the converter member actuates

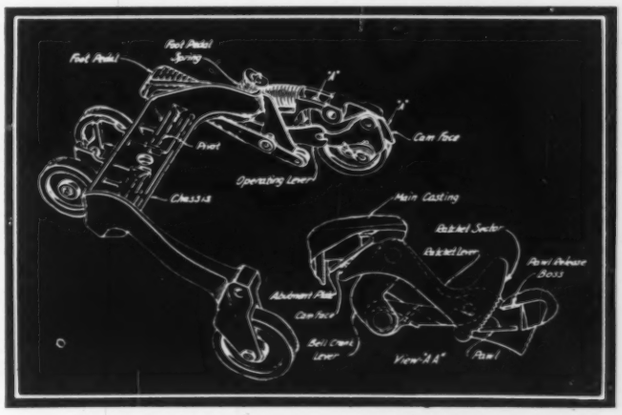


Fig. 5—Toe pressure adjusts height of nozzle through ratchet sector and cam face shown

the nozzle elevating lever which is pivotally mounted on the chassis, causing the nozzle to be raised a predetermined distance above the floor.

The chassis carries the wheels and has a pivotal connection with the casing, thereby enabling the cleaner body to tilt about a horizontal axis. The nozzle portion thereof is thus raised or lowered with reference to the floor level.

Foot Pressure Sets Adjustment

The correct setting of an electric cleaner for each different thickness of floor covering is not obvious to the average operator, nor has it been readily achieved heretofore with the more or less conventional types of adjusting mechanisms. The familiar markings "thick," "medium" and "thin," which are usually associated with such mechanisms, do not give a sufficiently accurate indication of the proper setting. Furthermore, the operator very often failed to make the necessary adjustment because a rather inconvenient manual operation was involved. If maximum cleaning ability is to be realized, however, it is important that the nozzle be adjusted properly to the carpet being cleaned.

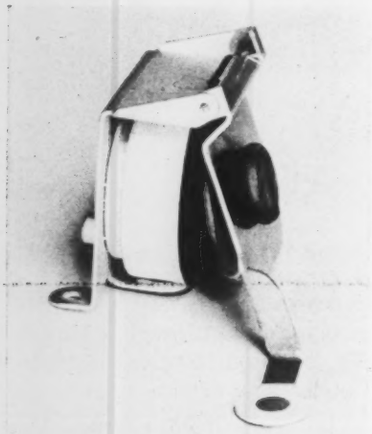


Fig. 6 — Rubber bellows operates signaling device which indicates pressure in the bag

The mechanism for this purpose is shown in *Fig.* 5. As explained previously, the chassis has a pivotal connection with the casing just forward of the rear wheels, thereby enabling the cleaner body to tilt about a horizontal axis. The nozzle portion of the cleaner is supported by the cam face of the ratchet lever as shown in the drawing, and its position with respect to the floor level is determined by the point at which the cam face contacts the inclined abutment plate.

At any given position of adjustment the pawl lever, under the tension applied to it by the torsion spring, is held in toothed engagement with the ratchet sector. Since the pawl lever is carried by the bellcrank lever and the latter held against movement by the operating lever and foot pedal spring, it follows that a constant nozzle height adjustment will be maintained as long as the relative positions of the various parts of the adjusting mechanism are not altered.

To effect an adjustment the foot pedal, which is at the extreme end of the operating lever, is depressed. This action immediately transmits a rocking movement to the bellcrank lever, which, in turn, imparts an endwise shifting movement to the pawl lever in a rearward direction, this movement being sufficient to release the pawl lever from the ratchet sector. The ratchet sector is now free to move and its angular displacement will depend upon the depth and type of carpet to which the nozzle is being adjusted.

Should the nozzle be too high with respect to the surface of the carpet, it will tilt downward by gravity until it rests upon the nap of the carpet. This movement of the nozzle will, in turn, cause a certain angular displacement of the ratchet sector depending upon the position from which it started to move. On the other hand, should the nozzle be too low with respect to the surface of the carpet its downward movement would be of less magnitude, or perhaps if it were already contacting the carpet nap, only the chassis would tilt forward and downward, the wheels tending to sink deeper into the pile. In this latter case the angular movement of the ratchet sector would be in the opposite direction since constant contact is maintained between the cam face and the abutment plate.

Immediately the foot pedal is released the spring takes effect and the bellcrank lever swings back, imparting an endwise shifting movement to the pawl lever in an opposite direction. Now the particular tooth which is engaged by the pawl when it comes into contact with the ratchet sector will not be the same one from which it was released at the commencement of the stroke because the ratchet sector has moved into a different angular position. Having engaged the pawl with the ratchet sector, the continued movement of the bellcrank lever carries the ratchet lever with it throughout the remainder of the movement imparted to it by the return stroke of the operating lever.

This enforced movement of the ratchet sector is translated into a rolling contact between the cam face and the abutment plate, which not only imparts a lifting movement to the casing, but controls the distance above the surface of the carpet through which the nozzle moves. This distance incidentally is variable and depends upon the location of the point of contact between the two cam surfaces at the commencement of the elevating movement of the nozzle, since it is this starting point which determines the angularity of the arc of rolling contact.

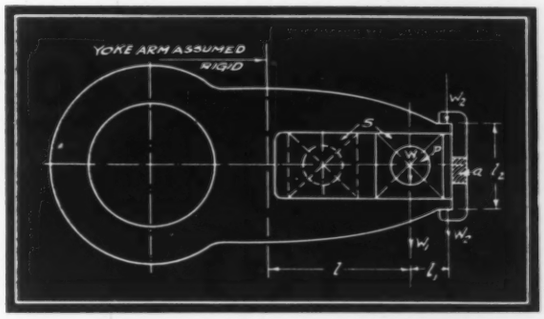
Cam Controls Nozzle Height

It was necessary to provide a cam of this type in order to compensate for the varying depth of wheel penetration on various types and thickness of carpet. To obtain the correct nozzle adjustment the amount of nozzle elevation must be greater in the case of a thick and soft piled carpet as compared to the relatively stiff and short nap carpet.

As will be readily appreciated, all the air that passes into the cleaner must pass out through the bag, and, if this bag becomes clogged due to being too full of dirt or due to the dirt working into the pores of the fabric, the cleaner cannot function properly. A signaling device (*Fig.* 6) which indicates pressure in the

(*Concluded on Page* 58)

Fig. 1—Direction of motion and force in this yoke are reversible so the part is symmetrical



Yoke-Type Arms Need Careful Analysis

By Clyde Hearne

FAMILIARITY with yoke-type members in machines certainly does not breed contempt for this type of part, but it may lead the designer to a neglect of the careful analysis of load distribution in the arms. This distribution is, in most cases, unequal. The problem is deserving of the time spent in its solution as failure may result if exact load distribution is not determined.

Fig. 1 shows a yoke in which slider *S* travels. The pin *P* either receives motion from or imparts motion to the shaft, the normal force between slider and yoke arm being *W*. The direction of motion and of force are reversible, so that the yoke will be symmetrical about a plane passing through the axes of the pin and shaft.

When the slider is in the position shown the bending moment $W \times l$ is maximum and is of a magnitude as to warrant carrying a part of the load from the lower to the upper yoke arm by means of a cross-tie. The bearing surfaces of the extreme ends of the yoke arms and of the cross-tie are accurately machined so that no slackness exists.

Must Consider Deformation

It will be noted that in *Fig.* 1 the length of the lever arm is taken as beginning at a point some slight distance to the left of where the yoke becomes solid. This is done because the deformation of the metal due to yoke arm stresses necessarily continues beyond the nominal beginning of the cantilever. This is an altogether negligible consideration in the ordinary structural cantilever in which the length is great as compared to the depth, but in cases such as the present one, where the cantilever is short and the depth great, an appreciable increase in the bending moment results when one makes a reasonable allowance for the continuance of the deformation beyond the point where the cantilever merges into the relatively rigid metal. It is the writer's practice in cases such as this to increase the effective length of the cantilever by from one-eighth to one-fourth of the depth at the fixed end; admittedly only a rough approximation.

In the present yoke, to estimate with a fair degree of accuracy what part of the total load each of the two yoke arms will carry, the following reasoning has been used.

Referring to the diagrammatic representation of the yoke given in *Fig.* 2, we see that:

The force applied to the lower yoke arm causes that arm to deflect downward, inducing tension in the cross-tie, which in turn causes deflection of the upper arm.

Disregarding the cross-tie for the moment, any load W_1 (an unknown part of the total load W) applied to the lower yoke arm will cause a deflection at W_1 of

$$\Delta_{w_1} = W_1 l^3 / 3 EI_1$$

where I_1 is taken as the median value of the varying moment of inertia between the left hand or fixed end of the yoke arm and the point of application of the load.*

Beyond W_1 the wearing face of the yoke arm will remain a straight line which is tangent at W_1 to the deflection curvature of the cantilever. We cannot, however, determine that curvature, nor its slope, since the moment of inertia of the cantilever is still unknown, and we must take recourse to the somewhat rough assumption that the end displacement is three-halves of what it would be if the wearing face remained straight throughout its whole length, as the cantilever was deflected.* Then, still without the restraining effect of the cross-tie, the end displacement is

$$\Delta_a = \frac{3L}{2l} \Delta_{w_1} = \frac{3L}{2l} \frac{W_1 l^3}{3 EI_1} = \frac{W_1 l^2 L}{2 EI_1}$$

Let W_2 be the load (a part of W) carried by the cross-

*For relatively small yokes the section of the arm might well be made rectangular and of uniform strength, or approaching uniform strength. The form then approaches the parabolic and a more accurate mathematical treatment becomes possible. The reasoning presented here was developed for a yoke large enough (24-inch, with well over two million inch-pounds torque) to necessitate adopting H-section arms, which are not easily treated mathematically.

tie, causing a deflection in the upper arm of

$$\Delta_{w_2} = W_2 L^3/3\,EI$$

where I is the median of the varying moment of inertia throughout the length of the cantilever.

Besides causing a deflection in the upper arm, W_2 also causes an elongation in the cross-tie, which is

$$\Delta_{l_2} = W_2 l_2/EA$$

where A is the cross-sectional area of the tie. The downward displacement of the extreme end of the lower yoke arm is therefore limited to

$$\Delta_u = \Delta_{w_2} + \Delta_{l_2} = \frac{W_2 L^3}{3\,EI} + \frac{W_2 l_2}{EA}$$

In other words, the pull of the cross-tie causes the end of the lower yoke arm beyond W_1 (the length l_1) to be deflected upward from its free displaced position by a quantity

$$\Delta_a - \Delta_u = \Delta_{w'} = \frac{W_1 l^2 L}{2\,EI_1} - \frac{W_2 L^3}{3\,EI} - \frac{W_2 l_2}{EA}$$

But the deflection of the extreme end of the lower yoke arm may be treated as that of a cantilever of length l_1:

$$\Delta_{w'_2} = W_2 l_1^3/3\,EI_2$$

where I_2 is the median of the varying moment of inertia through the span l_1.

Since, with the exception of the expression for Δ_a, all the above expressions hold true simultaneously, we may solve for W_1 and W_2 provided we can correlate the other quantities that have been regarded as variable. From a preliminary lay-out of the yoke we must see that $l_2 = kl_1$; also, the relationship of l to l_1 must be known so that we may write, for convenience, $l = cl_1$; $l + l_1 = L = (c+1)l_1$. Further, from the preliminary layout it must be apparent that some fairly definite relationship will exist between the moments of inertia I_1, I and I_2 so that we may say that $I_2 = (l/n)I_1$ and $I = (l/m)I_1$ On this basis the various expressions may be brought into such form that they can be solved as simultaneous equations, giving,

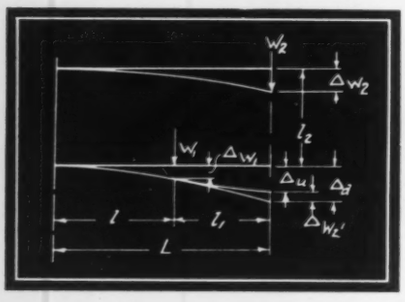


Fig. 2—Diagrammatic representation indicates direction of forces on the yoke arm

$$\frac{W_1}{W_2} = \frac{m(C+1)^3 l_1^2 A + 3\,KI_1 + nA}{m\,C^2 l_1 (C+1)A}$$

Denoting the numerator of the second fraction by x and the denominator by y, and remembering that $W_1 + W_2 = W$, we may write,

$$W_1 = \frac{W}{x+y} \times x \qquad W_2 = \frac{W}{x+y} \times y$$

It may be remarked that in the general run of cases very much less than half of the load will be carried by the upper arm, the upper arm sometimes relieving the lower arm by as little as only 10 per cent, showing the danger of drawing too hasty conclusions as to load distribution.

Car Refinements Mirror Design Trends

(*Concluded from Page* 30)

ing wheel and completes the solenoid circuit when the selector lever is in any speed position other than "direct." A centrifugal governor is driven by the speedometer gears at the rear of the transmission and is in series with the solenoid circuit and completes it when the car speed is under 17 MPH, *Fig.* 10.

The lightening of car weight accompanied by increased power has given the new cars better acceleration characteristics. Where slightly larger engines are used, the rear axle ratio has been made faster so that the piston travel per mile is reduced. Brakes have been improved chiefly by better sealing methods, excluding dirt and water.

Radiator grilles of the horizontal design predominate and are die-cast in most instances. They are sometimes blended into the hood louvres and give an apparent continuity of design. The hood tops invariably run to the radiator grille and eliminate any break in the surface that would decrease the apparent length. A one-piece hood top is a further step in this direction, having been previously introduced by Lincoln-Zephyr. Rear panels have been given a greater sweep and slope, a feature also spurred on by Lincoln-Zephyr. The body interiors are wider and in some instances longer, providing for greater comfort.

The mounting of Chrysler built bodies on the chassis frames includes a rubber spool supported by frame outriggers, of which there are fourteen. A tubular spacer prevents tightening the body bolts beyond a predetermined amount so that the full resiliency and cushioning of the gum rubber is obtained.

Buick and Oldsmobile utilize one of the running boards for a radio antenna by insulating it at the brackets to the chassis frame. License plates are centrally mounted on the rear panel or luggage lid with a tail light at each side. Oldsmobile places the tail lights high on the body at the termination of the body molding. Generators have increased output to cope with the greater demands for electrical accessories.

Thus do the new cars roll on to a new height of beauty and safety! Thus do the automobile designers parade the results of a year of intensive work which clearly shows the prospective buyer that today's automobile provides unprecedented value for his dollar.

Metal Show Stars Materials and Finishes

METALS protection by differential surface hardening, electrodeposited coatings and overlays vied with extensive displays of materials for major attention at the largest metal show ever staged by the Society for Metals at Cleveland. Also presented were testing and metalworking machines startling in their advances, and welding and cutting machines and processes that demonstrated the most advanced designs ever available. The show, classed as the most outstanding ever held, also attracted the largest registration in history. While materials were the basis for this show, designers indicated especial interest in protecting the metals they specify. One of the most closely-watched displays was that of Ohio Crankshaft Co., where actual production was carried out in the differential hardening of automotive engine crankshafts, the Tocco process, designed to harden bearing surfaces or other individual sections of a large part. Essentially the equipment involves a frequency changer, transformer, a series of inductor blocks which are perforated to admit quenching water and various auxiliary equipment. High frequency current at high voltage is transformed into low voltage with a high amperage through a water-cooled transformer from which it passes into the inductor blocks placed around the surface to be hardened. The inductor block in turn acts as the primary coil of a transformer inducing a current in the magnetic object to be heated through a minimum air gap. Heat generated in the steel is a result of two losses—hysteresis loss and eddy current loss. Instantaneous quenching is accomplished by pressure spraying through orifices on the inner faces of the blocks.

Bright Zinc and Cadmium Introduced

With metal finishing assuming more and more importance in the design of all types of machines, two exhibitors demonstrated modern methods of electroplating. Bright zinc barrel plating was shown in operation by the R. & H. Chemicals department, E. I. du Pont de Nemours & Co. Inc. This process is for producing durable, rust-resistant surfaces on steel parts and gives a more attractive finish than previous zinc coatings. In connection with it, the company introduced a new brightening agent, a liquid which is claimed to be easy to handle and control and is nonflammable, nontoxic and noncorrosive. Grasselli Chemical Co. Inc. demonstrated new cadmium plating equipment which also answered the demand for better appearance by producing a brighter cadmium plate, more in keeping with modern design trends.

Customary procedure in electroplating is to immerse the parts to be plated in the plating bath. This procedure has been reversed by Nickel & Chromium Products Co. which demonstrated that it is not only possible but practical to take the bath to the work. In the process the electrolyte is brushed on the work, and the method is said to be applicable to any surface which can be reached with the bristles of a brush. Equipment consists of a small transformer and rectifier which is plugged into any convenient alternating current socket and a special brush which becomes the anode when connected to the rectifier. The cathode tip is attached to the work. It can be used with both chromium and nickel.

Machine Varies Impact Velocity

Primary interest in the machines displayed was attracted by the variable velocity impact tester of Riehle division, American Machine & Metals Inc. In operation, the test specimens and tup are attached to the pendulum and with horns and counterweight retracted the wheel is brought up to speed by means of a 10 HP motor. At the desired velocity, measured by means of a tachometer, the external mechanism is tripped, releasing the horns which revolve outwardly due to centrifugal force, striking the tup and thereby rupturing the test specimen.

Among arc welding machine manufacturers the ac-

cent is being placed on the direct current machines. Precision control is featured by all types. One unit which employs standard coated rods is a true robot, operated by remote control. Alternating current arc welding machines and transformers still have a field where they are superior to direct current equipment, particularly where arc blow is a determining factor.

Gas cutting machines have taken a long step forward in the last twelve months. Until recently, manufacturers of this type of equipment apparently have feared to use full automatic control. Most existing machines are now obsolete and could be replaced by modern machines which would pay for themselves in a few months.

Although the exposition, including many other important design improvements and factors in addition to those noted, attracted considerable interest, the technical sessions held as an integral part of the Metal Congress were considered as being of equal or even greater importance by many engineers. Particular attention was given to the several papers on the welding of machinery and the torch cutting of parts.

Heavy Machinery Welding Is Covered

A number of the papers are of lively interest to machine designers, one of these being the one by Howard G. Marsh of Carnegie Steel Co., Pittsburgh, on rolled steel in machine construction, which was published in the October issue of MACHINE DESIGN. In a paper along somewhat similar lines by C. A. Wills and F. L. Lindemuth of William B. Pollock Co., Youngstown, O., welding of heavy machinery was covered, examples including broaching machines, large gears and their housings, shear frames and engine beds. Mr. Wills who made the presentation, emphasized that excessive weld metal is undesirable and that successful combining of several parts depends upon correct choice of welding rod and of materials having similar characteristics. He urged that appearance be given careful consideration.

Charles H. Jennings' paper on "Welding Design" is worthy of serious study by machine designers. The author, who is in charge of welding research in the Westinghouse Research Laboratories, dealt graphically and mathematically with a wide variety of welded junctures. Those illustrated in *Fig.* 1 are typical examples. This paper appears in full in the October, 1936 issue of *The Welding Journal,* from which the figure just mentioned has been reproduced.

In his paper on "Modern High Resistance Welding," A. E. Hackett of Thomson-Gibbs Electric Welding Co., Detroit, again bore down heavily on importance of appearance. According to him, there now is a tendency for projection welding to supersede spot welding. As an instance of the economy of welding, he cited a part which when made in one piece wasted forty-two per cent of the material as scrap. Through redesign as a two-piece part fabricated by welding, scrap loss was reduced to one and one-half per cent. This speaker mentioned resistance welding of cast iron as a process on which development is well advanced.

On the final day of the meeting sessions were sponsored by the American Society of Mechanical Engineers whose Iron and Steel and Machine Shop practice Divisions are taking active and constructive interest in both the theory and practice of gas and electric welding. One group of papers dealt with welding of copper alloys, monel metal, nickel and aluminum alloys. These nonferrous metals are being used to an increasing degree in machine design and the speakers, I. T. Hook of American Brass Co., F. A. Flocke of International Nickel Co. and G. O. Hoglund of Aluminum Co. of America, were asked numerous questions as to methods of meeting practical design problems. Mr. Gibson, chairman of this nonferrous session commented to the effect that now that welding has been available these many years we are at last really beginning to know something definite about it.

At the final session J. L. Brown of Westinghouse weighed relative values of cast and welded designs,

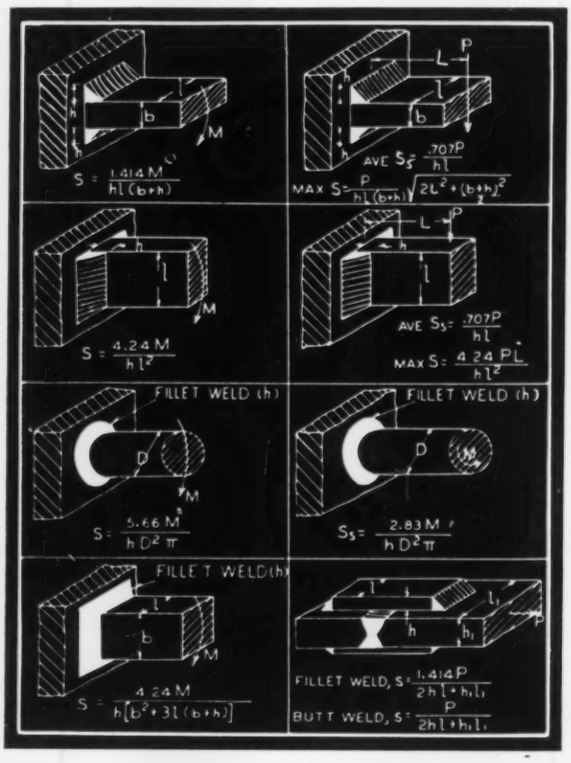


Fig. 1—A few typical welded joints and stress formulas covered in Jenning's paper on Welded Design

his paper being illustrated by examples of successful redesigns from cast to welded fabrication. The other two papers dealt with the vital subject of detection of subsurface flaws and faults in welds. H. R. Isenburger covered the use and interpretation of X-ray examinations while J. W. Yant explained the application and possibilities of tests by the use of magnaflux powder. Mr. Yant showed illustrations of patterns assumed by this powder over welds in magnetized parts and explained the significance of these magnetic patterns in terms of the hidden character of the welds on which the tests were made.

Gear Design Short-Cuts Aid Profile Selection

By J. Harland Billings
Professor of Mechanical Engineering, Drexel Institute

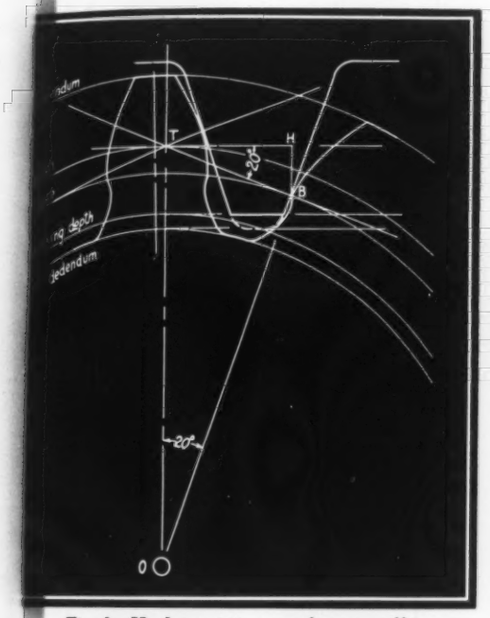
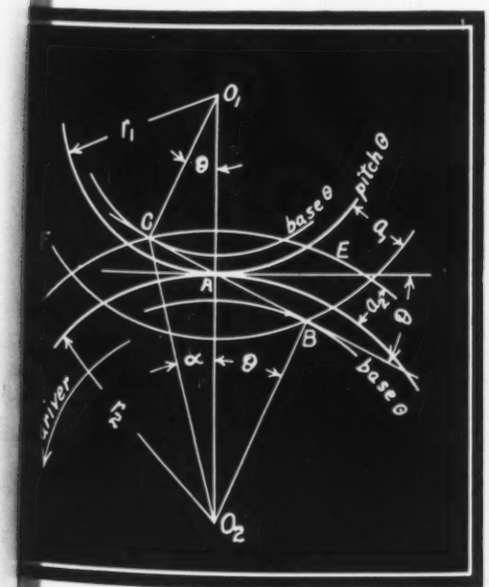


Fig. 1—Undercutting as shown will seriously reduce the tooth cross-section

Fig. 2—Limits of tooth contact that will be free from interference are indicated



PROPER selection of toothed gears for a given transmission involves the characteristics and heat treating possibilities of the materials available, the strength and wear limitation, and such choice of tooth form and tooth numbers as will avoid excessive undercutting on the one hand and low contact ratio on the other. This article deals briefly with the last requirement and gives some short-cuts in the form of curves which the writer has found considerably facilitate the finding of the best combination of tooth numbers and tooth form for a given application.

A 14½-degree involute full depth tooth of American Gear Manufacturers' association (AGMA) standard form, has the outline shown in *Fig.* 1 when the number of teeth in the pinion is twelve. Such undercutting as this small gear shows seriously reduces the cross-section of the tooth where its maximum strength and stiffness is required. It is a condition that must be avoided if the application is to approach the economy possible in the use of involute outlines. What are the variable factors that control undercutting in this case?

Pressure Angle an Effective Factor

A very effective factor is the pressure angle. If, for example, the pressure angle is increased to 20 degrees, the undercutting is considerably diminished and with 25 degrees entirely disappears. Another factor is the number of teeth in the gear or pinion in question. Suppose the number of teeth in the first mentioned 14½-degree gear shown in *Fig.* 1 has its number of teeth increased to 32. The result will be an entire disappearance of the undercutting difficulty. The similar result for the 20-degree full depth gear will be obtained by increasing its number of teeth to only 18.

The foregoing conclusions hold only for gears cut by hobs or other cutters of rack form. If a Fellows shaper cutter were used on the gear of *Fig.* 1 the undercutting would be somewhat reduced depending on the number of teeth in the cutter. Another factor is the tooth length, particularly the addendum of the cutting tooth. If the AGMA 20-degree stub addendum which is 0.8 divided by the diametral pitch, were used, the number of teeth in the gear could be reduced to 14 without undercutting. Obviously the addendum of the teeth of the mating gear cannot be longer than the addendum of the cutter teeth. It is apparent that there are four independent variables controlling the problem of whether a given gear will be undercut or not, namely pressure angle, number of teeth in the gear, theoretical number of teeth in the cutter and the addendum length of the cutter teeth. The relations existing among these variables will presently be derived.

So far, attention has been directed to the gear tooth and the cutter which

[1] Design for strength and wear is summarized in the *Handbook of the American Gear Manufacturers' association.*

produces it. Referring again to *Fig.* 1, the relation between the gear tooth and the rack cutter by which it is cut is identical to the relation between the gear and a mating rack with the exception that the cutter tooth must carry an extension—shown in broken line in *Fig.* 1—to cut the clearance. This extension, of itself, produces small additional undercut, which amount will be neglected in our development.

Severe Undercutting Probable

Considering *Fig.* 1 then, to represent a rack and pinion in mesh, the addendum of the rack tooth could not be longer than HB to avoid the necessity of undercutting or to avoid interference if the pinion were not undercut. Calling the pressure angle θ, the pitch radius of the pinion $OT = r_1$, and the allowable rack addendum $HB = a_2$,

$$a_2 = r_1 \sin^2 \theta \quad \ldots\ldots (1)$$

from the similar triangles THB and OBT. The subscript 1 refers to the pinion, subscript 2 to the rack and later to the larger of a mating pair.

As the pitch radius of the pinion and its number of teeth increases, a_2 increases. When a_2 equals the standard addendum, standard gears can be used without undercutting. From equation (1) with $\theta = 20$ degrees and standard full depth addendum of $1/DP$, where DP is diametral pitch,

$$a_2 = a_1 = (1/DP) = (2r_1/N_1) = r_1 \sin^2 20 \text{ degrees} \quad \ldots\ldots (2)$$

or

$$N_1 = 17.1$$

Thus no undercutting difficulty will be encountered with such standard racks and pinions provided the pinions have 18 or more teeth.

Can Evaluate Addenda Limits

For the general case of two gears, *Fig.* 2, the points B and C are the limits of tooth contact that will be free from interference or undercutting. The corresponding limits of addenda are a_1 and a_2 which can be evaluated from the geometry of the figure. The numbers of teeth in pinion and gear are designated by N_1 and N_2 respectively.

$$a_2 = \sqrt{(r_1 \sin\theta + r_2 \sin\theta)^2 + r_2^2 \cos^2\theta} - r_2 \quad \ldots\ldots (3)$$

which reduces to

$$a_2 = \sqrt{(r_1^2 + 2r_1 r_2)\sin^2\theta + r_2^2} - r_2 \quad \ldots\ldots (4)$$

and further to

$$a_2 = r_2 \left[\sqrt{(r_1^2/r_2^2 + 2r_1/r_2)\sin^2\theta + 1} - 1 \right] \quad \ldots\ldots (5)$$

Since

$$r_1 = N_1/(2 \times DP), \text{ and } (r_1/r_2) = (N_1/N_2)$$

$$a_2 = \left[N_2/(2 \times DP) \right] \left[\sqrt{(N_1^2/N_2^2 + 2N_1/N_2)\sin^2\theta + 1} - 1 \right] \quad \ldots\ldots (6)$$

Similarly

$$a_1 = \left[N_1/(2 \times DP) \right] \left[\sqrt{(N_2^2/N_1^2 + 2N_2/N_1)\sin^2\theta + 1} - 1 \right] \quad \ldots\ldots (7)$$

It should be noted that a_2, the critical addendum of the larger gear is the lesser of the two addenda so its value compared with standard addenda will indicate whether

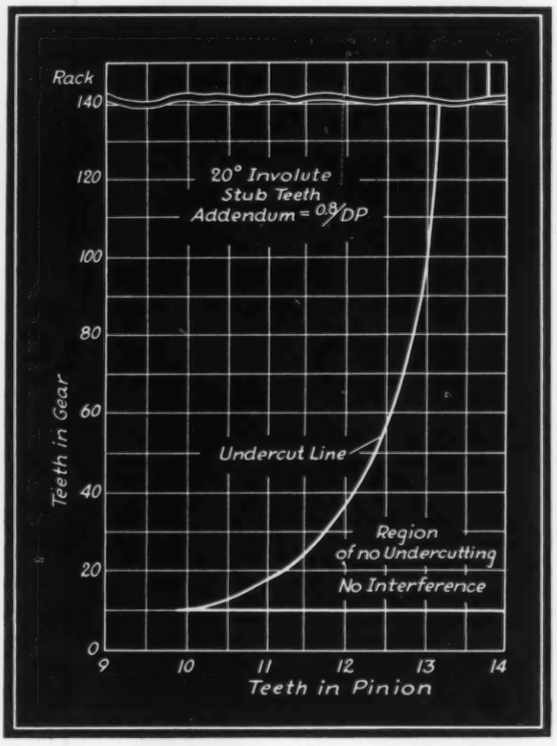


Fig. 3—A definite series of dimensions which will have no undercutting can be determined

or not standard gears will be undercut. For any ratio N_1/N_2, and number of teeth in the larger gear, N_2, the value of a_2 is given by equation (6) and can be compared with the standard addendum. Such procedure, together with the use of equation (2) for the rack and pinion values, yielded the curves of *Figs.* 3, 4 and 5.

Design Avoids Undercutting

A few specific cases will illuminate the use of the curves. Suppose a pair of spur gears is required to give a speed ratio of 20 to 7 and it is desired to use 14½-degree full depth form if possible. *Fig.* 3 shows that the pair having 60 and 21 teeth give a state point much to the left of the undercut line indicating that severe undercutting would result. An 80 to 28 pair give a state point to the right of the undercut line or in the region of no undercutting. If 20-degree full depth outlines were considered, *Fig.* 4 indicates that both the 80 to 28 and 60 to 21 combinations are possible without undercutting difficulties. Using 20-degree stub teeth

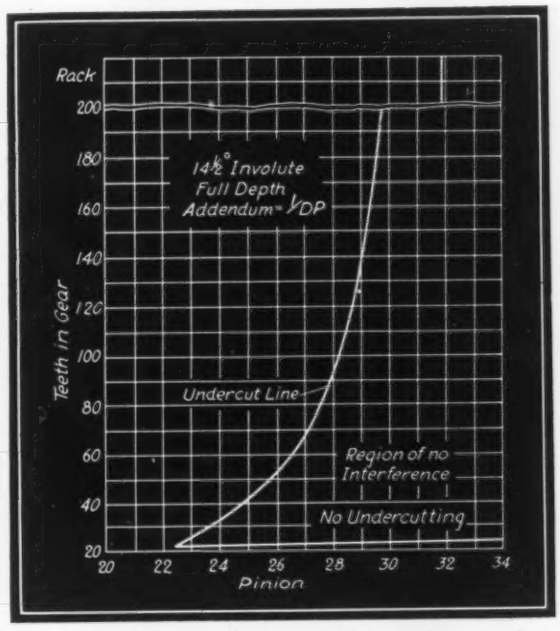


Fig. 4—Correct combinations of gear factors that insure no interference are shown to the right of this curve

Fig. 5 shows that the 40 to 14 tooth pair will meet the specification without undercutting.

A certain specification calls for a 100-tooth gear meshing with a 16-tooth pinion. What outline will be satisfactory? The answer from the curves is that the 20-degree full depth form is just right, the 14½-degree full depth form will be severely undercut and the 20-degree stub teeth are much too short to give undercutting difficulty.

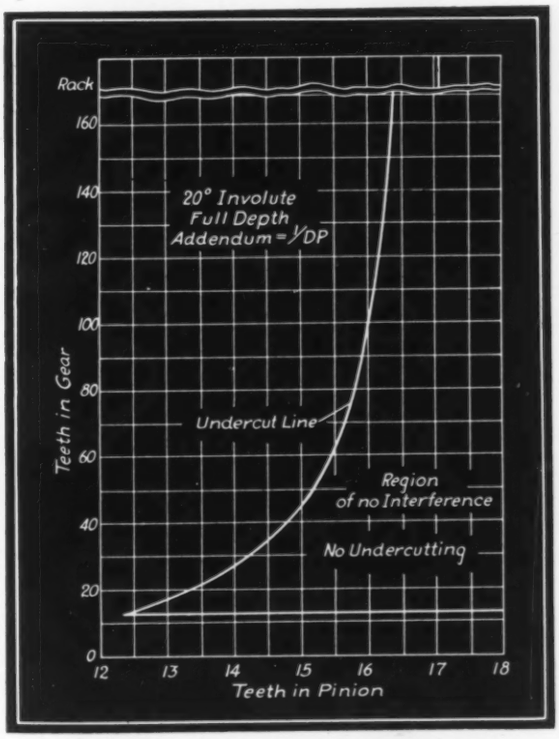


Fig. 5—Contact ratios that meet exact specifications insure correct gear action at all times

An important consideration in choosing gear combinations is contact ratio. Contact ratio is the angle through which a gear tooth is in driving contact divided by the angle subtended by the circular pitch. Experience indicates that 1.4 is the minimum desirable contact ratio for spur gears. This means that forty per cent of the time two pairs of teeth are in transmitting contact and sixty per cent, one pair. A large contact ratio is desirable but this minimum allows the incoming pair of teeth to become deflected and adjusted to the pressure before the outgoing pair begins to unload. Referring again to *Fig.* 2, the maximum useful driving contact is from *B* to *C* but this would be possible only with unequal addendum gears. For equal addendum standard gears the maximum useful contact is twice *AC* and beyond this undercutting begins.

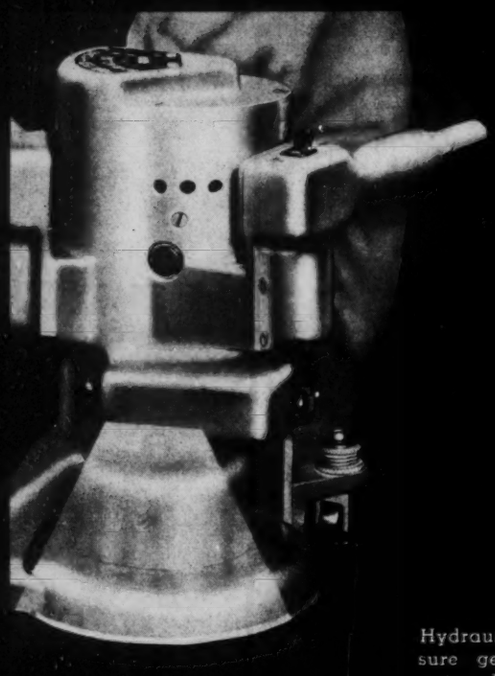
A few other useful facts are shown by these curves. A 14½-degree full depth gear of 28 teeth, *Fig.* 3, will have to be undercut to mesh with a rack. If so cut, it will mesh without interference with any gear down to 24 teeth. Conversely, suppose this 28-tooth gear were cut by a Fellows shaper cutter having 40 teeth, the curve shows that it would mesh properly with gears of from 24 to 93 teeth but would interfere if meshed with gears from 93 teeth to a rack, cut by either the 40-tooth Fellows cutter or by cutters of rack form.

Inventions Stimulate Living

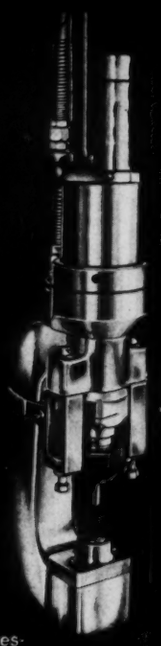
THE experience of living has been tremendously stimulated by the inventions of our age. We do, as a simple matter of course, things unheard of before our day. A few examples will suffice to illustrate what I have in mind: By means of refrigeration and fast transportation the food which we have today enjoyed came from far distant climes and passed through many hands before it reached us. Modern transportation has changed the lives of all of us. Our homes are filled with amazing conveniences and devices. The average citizen of this Golden Age puts to work for his convenience ten times as many metals, minerals, woods, fibers and what not, as did the Englishman of Queen Elizabeth's time.

"The statement that employment has increased during the last fifty years sounds impossible in view of the publicity given to the unemployment blamed on labor saving machines. 'One machine to do the work of ten men' reads the headline. But this very machine would absorb part of these ten men: some to make it, one or two to keep it and its sisters in repair. It would make goods cheaper, which would stimulate the sale of the goods made, which in turn would make more machines necessary, and so on.

"Not a single modern invention or device would have attained the position it holds in our life but for the fact that we needed it, we had use for it, we wanted it. Each new machine or device added in some manner to our enjoyment and pleasure, or in some way was valuable to us. Unless this is true no invention gets beyond the laboratory or shop."—A. W. ROBERTSON, chairman, Westinghouse Electric & Mfg. Co.



aluminum frame of Porter-Cable
ry floor edger, above, is given an
ization-preventative coating to pro-
a lasting finish. A hardened steel
me-plated guard surrounds the re-
ng disk to prevent the marring of
boards. Flood lights for illuminat-
the working surface are built into
rame. A filter in line with a 15
ere switch prevents radio interfer-



Hydraulic power from a pressure generator, consisting of motor driven oil pump, automatic electric valve unit, and oil reservoir, operates the Hannifin portable high speed punch, right. A pushbutton on the handle of the punch controls the entire operation of the unit.

Timing latch on Red Diamond beverage
bove.
so that the tilting of bottles and the pause be
n tilts
the fluid. A new type magnetic brake, built
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necessity for any overload clutches. The feed
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gate which stops the machine should a bott
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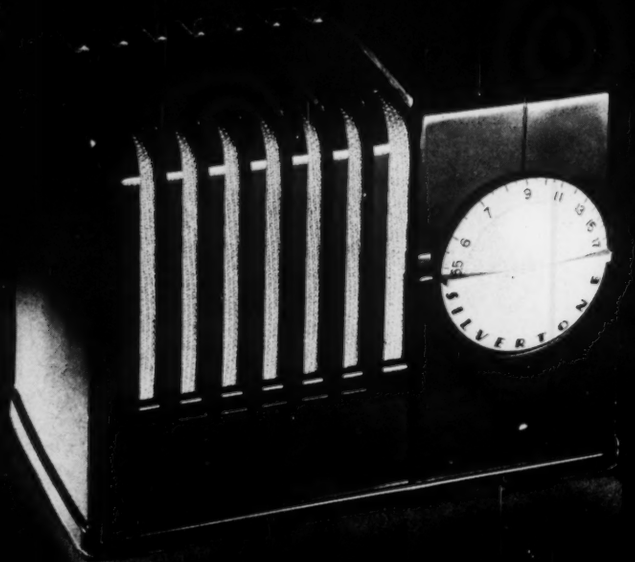
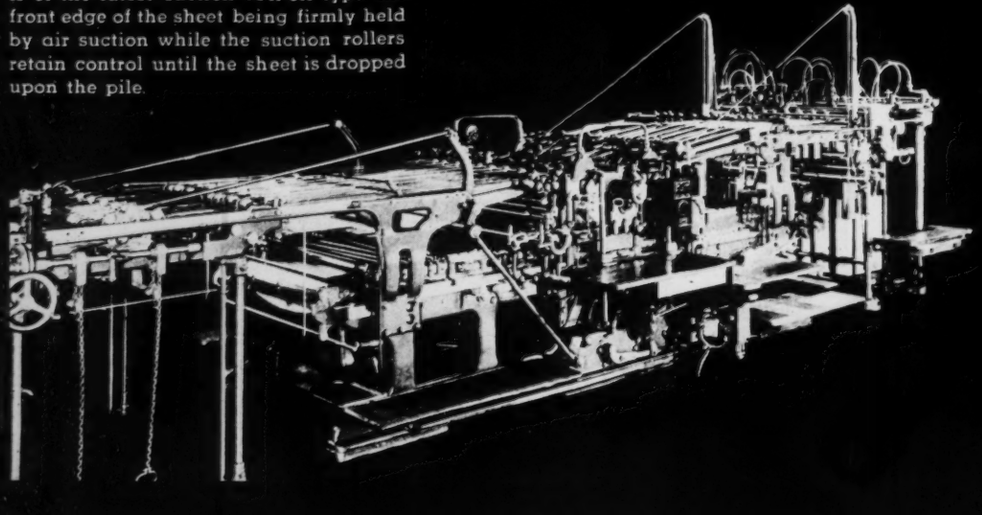


award in a plastics design com-
on has been given this Sears radio.
With a case molded of Durez, the
urther employs plastics in the light-
ed dial which provides a tone con-
Straight line vertical columns for
rille simplify molding operations.
ase is open at the bottom, rather
at the back, giving the radio an
ly pleasing appearance from all

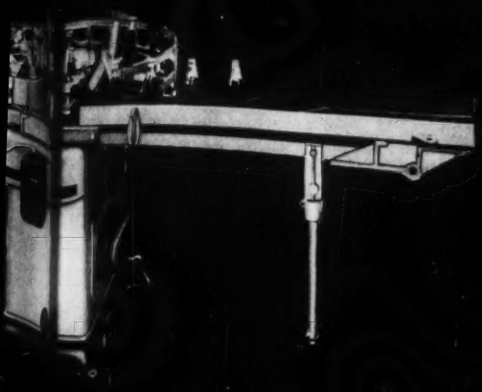
Designfe
in New Ma

**A Pictorial Presentati of R
from the Standpoint**

Front end of the feed board on Miehle
two-color press, below, is counter-bal-
anced so that it can be easily raised for
access to the cylinder, thus carrying out
a requirement in this design that all
parts be easily accessible. The delivery
is of the latest suction roll-off type, the
front edge of the sheet being firmly held
by air suction while the suction rollers
retain control until the sheet is dropped
upon the pile.



Electrical contacts through holes punched in the cards actuate the distribution on this International sorter, right. The sorter, which automatically collects punched cards into accounting groups at the rate of 9000 cards per hour, has all mechanism reduced to the simplest possible combination to facilitate operation and servicing. Controls are fool-proof to prevent damage by inexperienced operators.



ge mix bove spaces the bottles properly
use be n tilts allows complete mixing of
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e feed quipped with an automatic safety
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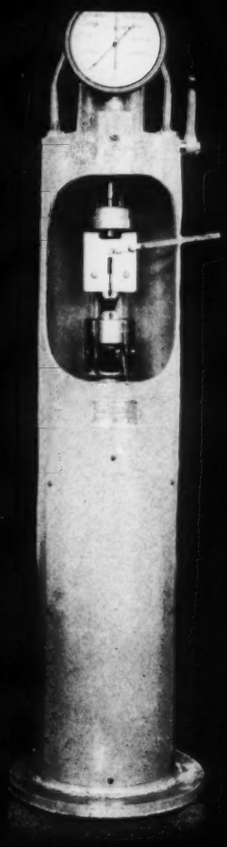
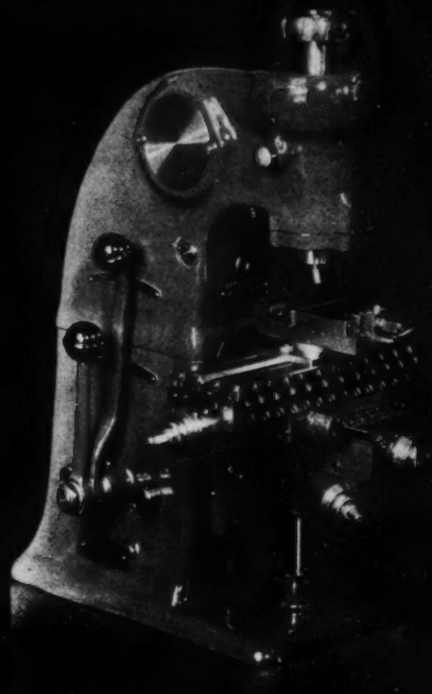


A specially designed type of self-aligning, lever operated, renewable file-face grip is used on new Southwark machine for testing the strength of spot welds, above. Fluid under pressure is pumped by a gear pump direct connected to a ¼ horsepower motor in the base of the machine. Top and bottom handling levers are set at right angles for convenient operation.



Designed for high spindle speeds with extreme precision and for the overcoming of radial and end play, the spindle construction of Hardinge vertical milling machine above embodies precision preloaded ball bearings of the double row type. This bench machine is fully enclosed to exclude dirt and to contain the driving belts to the spindle.

n Features
Machines

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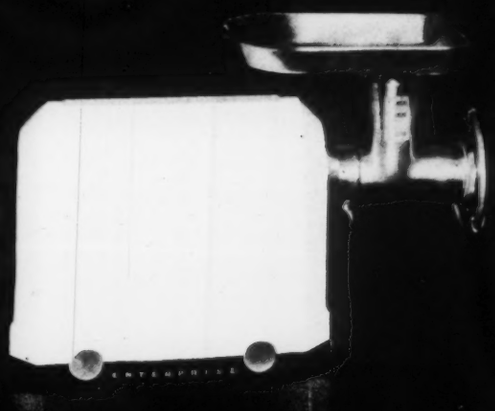
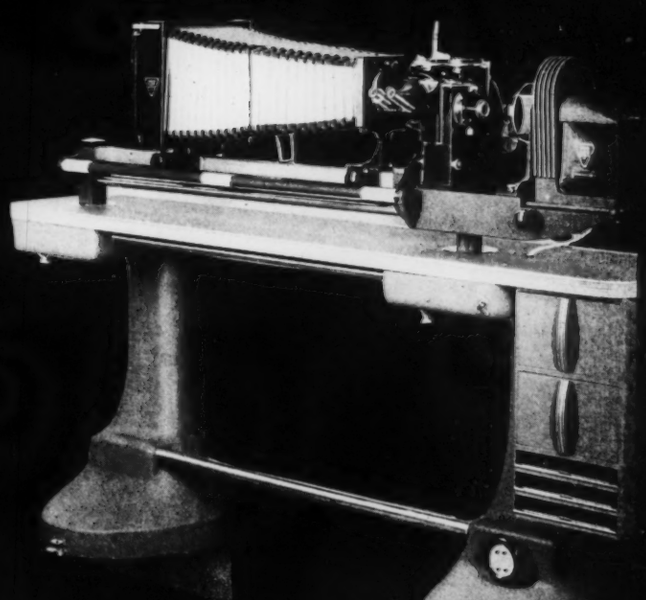


White molded plastics was chosen for the case of this Enterprise meat chopper, above, because of its appearance and the ease with which it can be kept clean. The use of the Plaskon hood and the zinc die cast base and front cover has permitted a considerable reduction in weight. The meat pan is of sheet steel, chromium plated. Motor is mounted on a steel frame placed on a gray iron gearcase. Meat pusher is black and white Catalin.



Arc lamp of the motor-driven type is employed on research metallographic equipment of Bausch & Lomb, right. The motor operates in a shunt circuit and, after the arc is struck, regulates the arc constantly. The microscope, is of the inverted type, including a circular revolving stage, rack and pinion coarse adjustment, fine adjustment and other equipment mounted in a rotating turret.

New Machines Indicate Design Trends

The days are gone when the designer made his machine "as cheap as possible." With improvement in business comes the demand for extra quality equipment. Parts which once were frankly planned as units which must be replaced periodically are now being specified from materials which will last the life of the machine. Corrosion resistant materials are the usual thing, rather than the exception. Also, protective coatings such as cadmium and hard surfacing, are being applied to all metal parts subject to attack. Quality in parts and materials has become the standard, and wide-awake designers are today designing machines for introduction within the near future that will be far ahead of anything previously seen in their respective fields.

Machines recently announced in addition to those on the preceding two pages include the following, arranged by fields of application:

Air Conditioning

Draftless Air Distributor, Anemostat Corp. of America, New York.

Brewery

Electric Label Paster, Scientific Filter Co., New York.

Beer Can Washer, Barry-Wehmiller Machinery Co., St. Louis.

Ceramic

Automatic Impingement Type Air Filter, Staynew Filter Corp., Rochester, N. Y.

Construction

Half-Bag Tilting Concrete Mixer, T. L. Smith Co., Milwaukee.

High Speed Excavator, Diesel or Gasoline Powered, Harnischfeger Corp., Milwaukee.

Concrete Mixer, Blystone Mfg. Co., Cambridge Springs, Pa.

Mesh Strike-Off Machine, Flexible Road Joint Machine Co., Warren, O.

Domestic

Stokers, Whiting Corp., Harvey, Ill.

Electric Clocks, Warren Telechron Co., Ashland, Mass.

Food Mixer, Alliance Mfg. Co., Alliance, O.

Automatic Oil Burner, Franklin Oil Heating Inc., Columbus, O.

Table Radio, International Radio Corp., Ann Arbor, Mich.

Home Light Plant, Continental Motors Corp., Detroit.

Food

Vacuum Deaerator, Croll-Reynolds Engineering Co., Inc., New York.

Industrial

Single Stage Steam Driven Horizontal Compressor, Sullivan Machinery Co., Michigan City, Ind.

Vapor Spray Degreasing Machines, Detroit Rex Products Co., Detroit.

Horizontal Three-Stage Compressors, Worthington Pump & Machinery Corp., Harrison, N. J.

Laundry

Self-feeding, Vacuum Shampoo, Rug and Carpet Scrubber, Continental Car-Na-Var Corp., Brazil, Ind.

Automatic Washer and Extractor, Bock Laundry Machine Co., Toledo, O.

Metalworking

Heavy Duty Snagging Grinders, Hisey-Wolf Machine Co., Cincinnati.

Horizontal Broaching Machine, Oilgear Co., Milwaukee.

Hand Miller, Producto Machine Co., Bridgeport, Conn.

Roller Pipe Cutter, Landis Machine Co., Waynesboro, Pa.

Abrasive Cut-Off Machine, Challenge Machinery Co., Grand Haven, Mich.

Grinder with Capacitor Type Motor, Baldor Electric Co., St. Louis.

Office

Keyboard Check Protector, Hedman Mfg. Co., Chicago.

Special Numbering Machine, American Numbering Machine Co., Brooklyn, N. Y.

Packaging

Automatic Can Filler for Canning Lubricating Oils, S. F. Bowser & Co., Ft. Wayne, Ind.

Printing

Block Leveler, Hacker Mfg. Co., Chicago.

Heavy Duty Paper Drill, Challenge Machinery Co., Grand Haven, Mich.

Vertical Photo Composing Machine, Lanston Monotype Machine Co., Philadelphia.

Restaurant

Automatic Bun Toaster, McGraw Electric Co., Minneapolis.

Textile

Rewinding Machine, Fidelity Machine Co., Philadelphia.

Bias Collarette and Strip Cutting Machine, J. A. Firsching Inc., Utica, N. Y.

Welding

Portable Arc Welders, Ideal Electric & Mfg. Co., Mansfield, O.

Woodworking

Veneer Jointer, Merritt Engineering & Sales Co. Inc., Lockport, N. Y.

Design of Automobile Symbolizes General Machine Trend

AUTOMOBILE shows now in full swing are far from being exhibits intended for the engineer or the design of other types of machinery. Yet there is no denying that the automobile has influenced design of other classes of machines more than any single factor over the past several years.

Would the antifriction bearing, for instance, have gained headway as it did but for the fact that motor car designers were quick to sense its possibilities? Would the quiet and smooth operation now synonymous with good machines have gone ahead so rapidly if it were not for the application in automobiles of helical gears, insulation materials, rubber mountings and other methods for achieving this purpose? Last but not least, would the present dominant trend toward compactness, enclosure and smoothness of line in practically every other type of machine have progressed so far if the lead in this direction had not been taken by car manufacturers?

We would be the last to say that automobile design is perfect or that equally notable advances have not been made in any other machines. The fact remains, however, that taken on the whole the automobile leads the way. And one method that assists them is a "customer consciousness" such as exhibited by few other builders of machines.

General Motors' questionnaire survey is just one example. Over a million replies are said to be received annually—surely sufficient to give, when interpreted, a clear picture of the likes and dislikes of the potential buyer. Other machinery builders might well adapt this idea to their own individual needs, and create a constant flow of users' comments to assist the engineer in designing machines that will speed complete recovery.

• • •

Appearance Aids Effectiveness

IT IS doubtful whether more than five per cent of the readers of technical magazines realize there are vast differences in the type faces of the printed matter, in the type for article heads, or in general layout of pages. Just as appearance in machinery, however, is a vital factor to be considered by the designer, so is visual appeal—even in the pages of technical journals—one of the many considerations of the editor.

Next to value of editorial material comes attractive, compelling presentation. Speaking for MACHINE DESIGN, constant effort is made not only to present authoritative design information on parts, materials and finishes on all classes of machinery "from wrist watches to locomotives," but to present it capably and well.

In the current issue will be noticed a new type face, clear and easily-read, new head types and other changes. All these are made with you—the reader—in mind. We hope you will like them, or tell us if you don't.

"Puzzlers" Reveal Spring Design Factors

DESIGN problems, and questions about details of design have a disconcerting habit of bobbing up periodically in identically the same form in widely separated parts of the country. It is only through the interchange of information from one designer to another that industry as a whole can progress. One of the fields where duplication of problems has come up frequently is the spring industry. A most complete listing of questions on this type of design, "Spring Puzzlers,"* is given in the following.

1. *Is it more expensive to make a closed end compression spring than an open end one?*

The expense of making a plain end spring is about the same as that of one with ends squared only, the only difference being in the extra amount of stock it takes to square the ends.

2. *What is considered a good radius for bends on torsion springs?*

A radius equal to the diameter of the wire being used is considered practical on most spring materials.

3. *Is an extension spring wound with initial tension stronger than one wound slack?*

An extension spring wound with initial tension is stronger than one slack wound by the amount of initial tension put into the tension-wound spring.

4. *What can be considered a safe stress below which it is not necessary to remove set?*

Springs which have a solid stress below the following figures may be manufactured without the necessity of removing set: Phos. bronze—40,000; .032 inch music—140,000; .032 inch—.062 inch music—110,000; .062 inch—⅛ inch music—100,000 to 110,000; ⅛ inch and heavier music—90,000; Hard drawn stainless steel 18-8 up to .080 inch—90,000; and .080 inch and heavier—75,000—80,000.

5. *On a compression spring does the second one-quarter inch of compression vary from the first or is it the same?*

The first one-quarter inch of compression of a compression spring must be the same as the second, because the gradient is uniform, which acts according to Hooke's Law; i.e., stress divided by strain is equal to a constant for any material. As the modulus of elasticity is constant in the same material, the unit deformation must be uniform according to the stress. One difficulty which frequently arises on closely calibrated springs is the fact that the active length of wire sometimes shortens up during the period of compression thereby slightly increasing the gradient as the change takes place.

6. *Which type of loop is considered the safest, twisted or loops to center?*

A twist loop is safer than the conventional loop to center because the bending of the wire in the formation of a twist loop is less severe.

7. *Does plating reduce the efficiency of springs and, if so, why?*

Plating, such as copper, cadmium, nickel, brass, and chrome does not materially reduce the efficiency of a spring if properly handled during the cleaning and plating processes. There are, however, several other finishes which we do not recommend for spring materials, due to a chance for greater embrittlement.

8. *What kinds of material stand up best under temperatures and to what degree?*

Regarding the effects of elevated temperatures on springs, each material has a limiting temperature, below which stress and temperature are the controlling factors and above which time is the important factor. These limiting temperatures varying from 200 degrees Fahr. to 700 degrees Fahr. for ferrous alloys, the stainless steel and high speed steel showing best results. Monel metal shows a good resistance up to 400 degrees Fahr.

Some figures which may be taken into consideration when designing this type of spring follow:

Tempered carbon steel used at low stresses up to 400 degrees Fahr. without losses in load over 5 per cent.

Music wire, which is a highly work-hardened material, has a tendency to lose its carrying capacity rapidly after reaching 200 degrees Fahr. when stressed up to 80,000 pounds per square inch.

Chrome vanadium up to 400 degrees Fahr. at stresses up to 65,000 pounds per square inch without any appreciable loss of load.

Stainless steel up to 500 degrees Fahr. stressed up to 70,000 pounds per square inch without loss of over 4 per cent.

High speed steel stressed up to 40,000 pounds per square inch up to 700 degrees Fahr.

9. *Is a barrel-shaped spring more expensive to make than a straight one?*

A barrel-shaped spring is more expensive to produce than a straight diameter spring only by the extra amount of wire which may be required in the barrel-shaped spring.

10. *Is there any set rule whereby springs as a whole can be made to a standard set of commercial limits, or does each spring present separate problems as to so-called commercial limits?*

There is no set rule for production of springs to commercial standards as each spring has its own problem and each spring shop its own quality.

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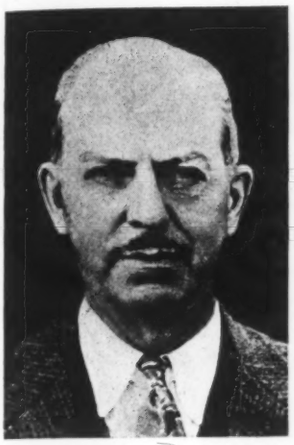
*Abstracted from *The Mainspring* of Wallace Barnes Co., Bristol, Conn.

MEN of MACHINES



HARRY A. MILLER

EARLY experience as a toolmaker on the building of steam and gas engines laid the foundation for the career of Harry A. Miller, noted designer and builder of racing cars. Mr. Miller, as vice president in charge of engineering of the American Bantam Car Co., Butler, Pa., now brings his genius directly to bear upon design of motor vehicles manufactured on a production basis. Behind the success of his racing cars has been Mr. Millers' years of work on the improvement of gasoline engines and carburetors. Principles developed by him have been applied to motor boat and aircraft engines, as well as to automobile engines.

Many have been familiar with the Miller name but few have realized that the man himself is a skilled mechanic and competent engineer whose work has been of great practical value to the automotive industry in the improvement of commercial vehicles as well as of pleasure cars.

• • •

ALFRED E. GIBSON

ELECTION of Alfred E. Gibson as president of the American Welding society gives added impetus to the program of welding research in which this organization is actively concerned. Mr. Gibson, who was born in Toronto, Canada, graduated in mechanical engineering from Ohio State university in 1909. He is widely recognized as an authority in the field of low alloy, high strength steels. Formerly president of the Fulton Foundry & Machine Co., he now is vice president and chief engineer of the Wellman Engineering Co., Cleveland. His knowledge of steel and of its fabrication by welding applies very directly to the heavy equipment built by this company.

In addition to his activities in the American Welding society, Mr. Gibson is a member of several other technical bodies including the American Society for Metals and the American Society of Mechanical Engineers.

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WILLIAM LITTLEWOOD

TRANSFER of interest from industries building heavy equipment to a field concerned primarily with very light equipment is an unusual feature in the career of William Littlewood, chief engineer of American Airlines Inc. Mr. Littlewood, following his graduation in mechanical engineering from Cornell university in 1920, joined Niles-Bement-Pond Co., builders of large machine tools. He served with them for four years—as inspector, tool room foreman, general shop foreman and assistant superintendent. He then spent three years in the Cameron, Phillipsburg and Eastern plants of Ingersoll-Rand Co. His shift in the direction of aviation began in 1927 when he became production manager of Fairchild-Caminez Engine Corp.

After three years with this aircraft engine builder and its successor, Fairchild Engine Corp. as production manager and general manager, Mr.

Littlewood became connected with the engineering staff of American Airways, of whose successor he now is chief engineer. On the occasion of the 1936 annual meeting of the Society of Automotive Engineers, Mr. Littlewood had the distinction of being given the Wright Brothers award. This award was made in recognition of his paper, "Operating Requirements of Transport Planes," which was presented during the 1935 meeting of the Society.

♦ ♦ ♦

W. E. MAHIN, heretofore identified with the Vanadium Corp. of America at its research laboratory at Bridgeville, Pa., has joined the East Pittsburgh works of the Westinghouse Electric & Mfg. Co. as metallurgical engineer.

♦ ♦ ♦

ROY E. COLE has been appointed vice president in charge of engineering, Studebaker Corp., South Bend, Ind. Mr. Cole was formerly chief engineer of the Dodge Motor Co. and later of Rockne Motors, a Studebaker subsidiary.

♦ ♦ ♦

WILLIAM S. JAMES has been made chief engineer of the Studebaker Corp. He joined the company in 1926 as head of the research engineering department.

♦ ♦ ♦

D. A. ROBERTS, formerly with W. E. Mowry Co., St. Paul, has joined the metallurgical research staff of Battelle Memorial institute, Columbus, O.

♦ ♦ ♦

M. E. LEEDS, president, Leeds & Northrup Co., Philadelphia, recently received from the Polytechnic institute of Brooklyn the honorary degree of Doctor of Engineering, and from the Institute of Management the Gantt medal "for distinguished achievement in industrial management as a service to the community."

♦ ♦ ♦

GEORGE TORRENCE, former president of the Link-Belt Co., has been made vice president and general manager of the Rayon Machinery Corp., Cleveland.

♦ ♦ ♦

H. S. CARD, former editor of *The Welding Engineer*, has been appointed development director of the newly organized Electric Welding section of the National Electrical Manufacturers' association, with headquarters in Pittsburgh, Pa.

♦ ♦ ♦

GEORGE H. BUCHER has been elected executive vice president of Westinghouse Electric & Mfg. Co. He joined the company in 1909 as a graduate student at East Pittsburgh, after following courses in machine design and steam and electrical engineering at Pratt institute, Brooklyn, N. Y.

♦ ♦ ♦

CHARLES F. SCOTT, professor emeritus of electrical engineering, Yale university, has been re-elected chairman of the Engineers' Council for Professional Development. (Note: An illustrated biographical sketch of Dr. Scott appeared in the December, 1935 issue of MACHINE DESIGN).

♦ ♦ ♦

GLEN E. WIMMER has been made an instructor in machine design at Michigan College of Mining and Technology, Houghton, Mich. Mr. Wimmer, who holds a Master of Science degree from Iowa State college, had several years of drafting and engineering experience with the General Electric, Western Electric and Buick companies.

J. W. WEITZENKORN has become associated with the Ohio Ferro Alloys Corp., Canton, as director of research. He was formerly president of the Molybdenum Corp. of America.

♦ ♦ ♦

R. A. LABARRE has become chief engineer of the Covered Wagon Co., Mt. Clemens, Mich. His previous experience was with Murray, Fleetwood, Lincoln, Packard and Hupp organizations.

♦ ♦ ♦

IRVING WOOLSON, who for the past eight years has been connected with the designing and engineering departments of three divisions of the Chrysler Corp., has been made chief engineer of the DeSoto Motor Co., Detroit.

♦ ♦ ♦

J. H. MCELHINNEY, whose resignation from Lukens Steel Co., was noted in the October issue of MACHINE DESIGN, has been appointed assistant to the vice president of the Wheeling Steel Corp. A graduate of the University of Pittsburgh in 1909, Mr. McElhinney was consulting engineer with the Columbia Steel Co. prior to joining the Lukens organization in 1926.

♦ ♦ ♦

WALTER A. PARRISH has been appointed chief engineer of the Buda Co., Harvey, Ill. Prior to joining this company in 1928, he was with the Hudson Motor Car Co.

Obituaries

DR. S. M. KINTNER, vice president in charge of engineering, Westinghouse Electric & Mfg. Co., died recently in Pittsburgh. Dr. Kintner, who was born in New Albany, Ind., in 1871, graduated from Purdue University in 1894. After a year on telephone construction and operation, he joined the faculty of Western university of Pennsylvania—now the University of Pittsburgh—as assistant to the noted scientist Dr. Fessenden. Within a short time he was made professor of mathematics, later succeeding Dr. Fessenden as professor of engineering.

Dr. Kintner originally became connected with Westinghouse in 1903 in the research department. He was engaged primarily in railway motor development until 1911, when he resigned to become general manager of a company developing Dr. Fessenden's radio inventions. As president of this company, Dr. Kintner negotiated the sale of the Fessenden patents to Westinghouse, at which time he himself rejoined that company. After two years on radio developments he was made manager of the research department, and was elected vice president in charge of engineering in 1930.

Dr. Kintner was made an honorary Doctor of Science by the University of Pittsburgh in 1930 and Doctor of Engineering by Purdue in 1932.

Professional Viewpoints

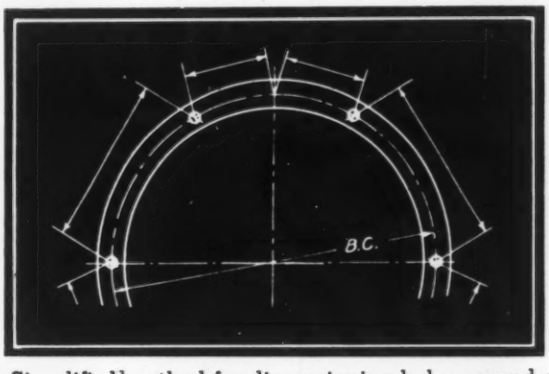
MACHINE DESIGN WELCOMES LETTERS SUITABLE FOR PUBLICATION

Standard Simplifies Dimensioning

To the Editor:

ON PAGE 31 of the October issue of MACHINE DESIGN, *Fig.* 5 shows two methods of dimensioning drawings locating bolt holes; one using angular dimensions is called incorrect—the other using horizontal and vertical dimensions is called correct. My past experience compels me to differ with the above statements. Possibly my views may interest your readers.

Where there is a number of holes equally spaced around a circle, this fact should be stated on the drawing. No dimensions are given for locating the holes, except of course the bolt circle diameter (*B.C.*). The machine shop can readily scratch the bolt circle on the casting while the casting is being machined. Moreover the machinist has one or more methods of dividing the bolt circle into an even number of parts.



Simplified method for dimensioning holes around a circle diameter is standardized

If the holes are not equally spaced, we find the angular dimension method is satisfactory where the angles are common ones, such as 22½, 30, 45, 60 or 90 degrees. The machinist can readily divide the bolt circle into the necessary number of equal parts to get one or more of these common angles.

In a case where the angle between two adjacent holes is an odd one, we do not consider the horizontal and vertical dimension method the most practical. In our shop most of the castings are of such a shape that it is impossible to scratch the vertical and horizontal center lines on them, and the foregoing method cannot be used. We find that in such a case the chord dimension method is preferable. On the accompanying drawing the bolt circle diameter (*B.C.*) is given, as well as the chord distance between each pair of adjacent holes. This illustration is a copy of a drawing standard which we use in our engineering department.

—DAVID FLIEGELMAN,
Coppus Engineering Corp.

Spot Welding of Aluminum Gaining

To the Editor:

THE illuminating comments anent "Why Weld?" on page 50 of your October issue, suggests to me a noteworthy advance along these lines in which you will undoubtedly be interested because of its wide possibilities. Spot welding of aluminum alloy non-structural parts is gaining wide usage in the aircraft field. Such assemblies as floors, seats, map cases, air ducts and similar secondary structures have been successfully assembled by this method for several years. Certain alloys are notably more readily adaptable to this method of fabrication than others. Difficulties in securing a perfectly uniform spot weld and the fact that imperfect spot welds are not entirely satisfactory under severe vibration, have limited the usefulness of this method of fabrication in aircraft primary structures up to this time. However, rapid strides have been made in the last year or two and it is believed that some primary structural welding in lightly-stressed parts may be used on production contracts in the near future. The method has many advantages from a cost standpoint, if reliability of such fabrication can be proved to be sufficiently great for aircraft usage.

—JOHN K. NORTHRUP, *president,*
The Northrup Corp.

Gives Length of Rolled Material

To the Editor:

THE length of tape or sheet material in a cylindrical roll, a figure of value to designers of many machines, can easily be shown to be $L=D^2—d^2)/15.3t$. In this, L, the length, is in feet while D and d, the out-

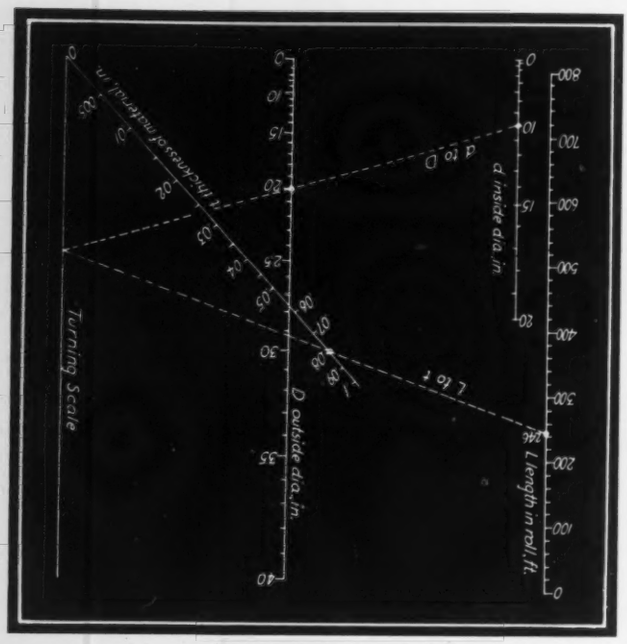


Fig. 1—Problem of determining length of material in a reel can be reduced to the form of a nomogram

side and inside diameters, and t, the thickness, are all in inches. If the roll is not closely wound, t is the pitch. The formula presupposes the roll to be made up of concentric circles instead of being spiraled, but this error is negligible if t is small with respect to D.

As an example of the use of the nomogram *Fig.* 1, the two dotted secants show that a roll of sheet material 0.08-inch thick (t) wound on a 10-inch core (d) to an outside diameter of 20 inches. (D) will contain 246 feet (L).

Fig. 2, based on the formula, is a curve for 16 mm film .0063-inch thick, when wound on a reel 1½ inches inside diameter. It shows the marking for outside diameters for a 7-inch diameter reel intended to hold 400 feet of film, for, say, each 50 feet of film length, and is thus a rough length gage.

—Carl P. Nachod, *vice. pres.*,
Nachod U. S. Signal Co. Inc.

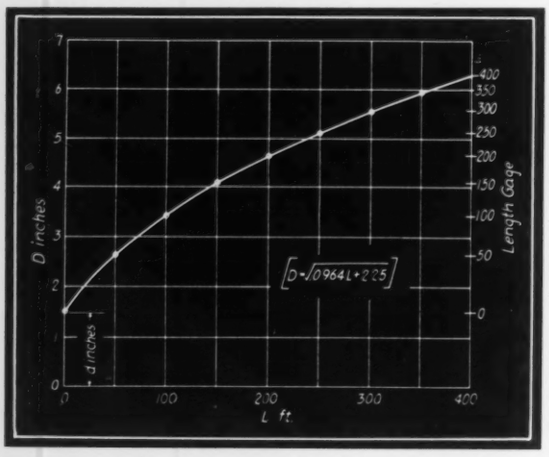


Fig. 2—Chart shows example for outside diameters of a film reel and gives length of film

Don't Limit New Design by Tradition!

(*Concluded from Page* 42)

bag therefore is employed, so that when this pressure exceeds a certain predetermined amount a small red disk shows through an aperture in the cleaner casting and indicates that the bag should be emptied. The device consists of a frame, a rubber bellows connected to the exhaust flange of the cleaner and a pivoted member actuated by the bellows. The pivoted member has an extension with a red warning signal upon it, and is normally held against the main frame by a torsion spring. This spring is adjustable in steps.

New Lightweight Materials Employed

There has always been some complaint that the electric vacuum cleaner is too heavy, and it was therefore specified that this new machine be much lighter than the machine it was to replace. To accomplish this and at the same time include the new features it was necessary that something different in materials be used.

Magnesium in the die cast form is equal in strength to aluminum and weighs one-third less. This material, therefore, is being used in all parts for which aluminum die castings would have been specified previously. Magnesium die castings up to the time of the start of manufacture of this cleaner had been made in this country only on a very small scale, and no parts of the large size required had ever been die cast. To make the problem more difficult there were no suitable machines available. It was necessary to develop and build machines and in addition, to develop the proper technique to produce magnesium die castings on a large scale.

The Hoover engineering department started its study of magnesium die castings several years ago and therefore was in a position to put a production program into effect. Nevertheless, there were numerous production difficulties to overcome in order to reach a schedule whereby over five thousand magnesium castings are turned out daily. The use of magnesium in the machine, however, has been well worth the large amount of time and expense that were expended in its development. Five parts as shown in *Fig.* 1 are made of magnesium. These weigh a total of four pounds and permit a saving in weight of two pounds per cleaner.

Thirteen parts of the cleaner are made from phenolic plastics. While the use of plastics is not new, the utilization of this material in structural parts to the extent to which it is employed in this machine is uncommon and necessitated the development of a molding technique quite different from any used heretofore. A background of experience on phenolic plastics aided the engineering department materially in this development. Thus it has been possible to produce precision parts that require practically no machining and are satisfactory as to strength and durability for structural members. The thirteen parts illustrated in *Fig.* 3 effect a saving of more than one and one-half pounds in the weight of the cleaner.

Noteworthy Patents

A PATENT recently granted to Albert B. Fuller of Rochester, N. Y., and assigned to the Eastman Kodak Co., covers a magnetic clutch to give smooth acceleration to motion picture projectors.

This clutch is depicted in the upper portion of *Fig.* 1 in conjunction with a synchronous motor, the electromagnet being built into the motor structure. End plate *A* is of iron and constitutes a magnetic core. Its poles *C* and *D* form an annular channel in which an exciting coil *E* is mounted. Ring *F*, composed of low resistance nonmagnetic material, encloses this annular channel and lies flush with faces *G* and *H* of the poles.

The mating assembly comprises an outer iron ring *K*, an inner iron ring *L* and an intermediate nonmagnetic ring *M* to which *K* and *L* are riveted. *L* is pressed on the rotor shaft, its inner cylindrical shell *N* being spaced by bushing *O*. This shell also extends into and is spaced from inner annular pole *C*. Ring *M* of this assembly has a facing *P* of friction material which projects beyond members *L* and *M*. Iron armature disk *Q* is integral with hub *R* running on roller bearings on an extension of sleeve *L*. This armature disk is normally free turning as far as the armature shaft is concerned.

Flexible coupling *S* is screwed to the outer hub of armature disk *Q* and from it extends load shaft *T*. This flexible coupling, which is simply a thin flat "spider" with three arms, permitting armature disk *Q* to move axially to the armature shaft when attracted by the electromagnet, without disturbing the position of the load shaft. Its spring effect restores the armature disk to neutral position when the magnet is deenergized.

When coil *E* is energized a magnetic field is induced in the iron parts of the clutch, the flux flowing across the radial air gap between pole *D* and the inside of rotating member *K*, thence through disk *Q* and back through the other rotating iron member *N*, across the air gap between *N* and inner annular pole *C*, as indicated by arrows in the cut.

The synchronous motor is brought up to speed with clutch disengaged, the load then being gradually picked up as the clutch takes hold. Rate of increase of magnetic flux is retarded: First, by providing high inductance in coil *E;* second, by making low resistance ring *F* of copper to limit inrush of current by virtue of eddy currents induced during the transient period; and third, by inserting fixed resistor *Y* in the clutch coil circuit. This is short circuited at the proper moment by a centrifugal switch mounted on load shaft *T*, as shown in the lower part of the illustration. Rollers *U* act like governor balls to pull cone *V* away from the button on spring finger *W*, causing contact

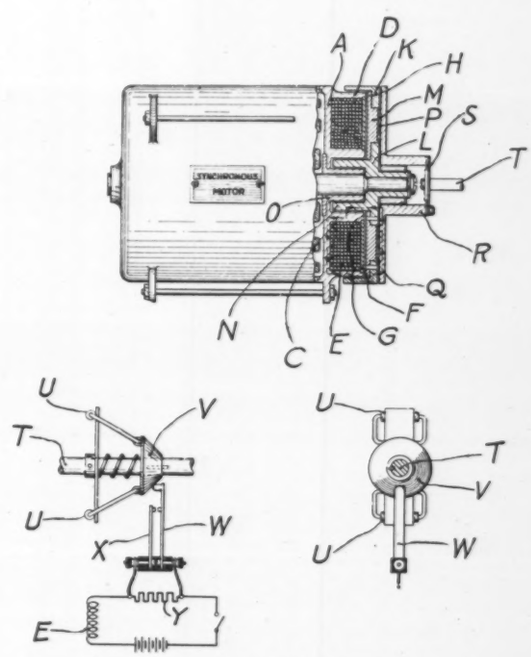


Fig. 1—Magnetic clutch built into frame of motor gives smooth acceleration

points on *W* and *X* to meet as the driven shaft *T* comes up to speed, thus by-passing resistor *Y*.

This patent is identified by No. 2,039,714.

DESIGNED for automatic slicing of bacon and similar slab materials, a machine invented by Charles T. Walter of Chicago embodies several interesting design features. The patent, which is No. 2,036,001, has been assigned to Swift & Co.

Two views of the machine are shown in *Fig.* 2, that to the right being a front view in section and that to the left a front end view. One of the primary objects in this invention is ". . . . to provide a knife of special configuration" which has a "draw cut" action throughout the slicing operation, winding up with a downward chopping action combined with transverse drawing action to the full width of the slab. Cutting is made still more effective by a straight stationary blade across the end of the trough.

Design and action of this knife *A* is evident from the illustration, if it be considered that it is swung up and down by connecting rod *B* which links together a short crank on the rear end of the motor-driven revolving drive shaft with a long crank D on the rear end of rocking shaft *E* on the front end of which the knife is mounted.

While the machine is tilted so as to give a self-feeding effect to those slabs in the upper part of its trough, an adjustable intermittant feeding mechanism is provided for the slab being sliced. This consists of a row of sharply fluted rollers in the bottom of the trough and a row of smooth spring-backed hold down rollers which bear down on the top of the slab, causing the fluted rollers to get the necessary "bite" for feeding. The fluted rollers are actuated when the knife is up, by small worm wheels at their ends which mesh with long worm *G*. The worm is moved periodically by ratchet arm *H* which is swung up and down by link *K* actuated by eccentric *L* on the main drive shaft. Length of feed, which determines thickness of slices, is adjusted by setting the lower end of link *K* at the proper position in the long slot in the outer end of ratchet arm *H*.

The illustration shows the machine set up in con-

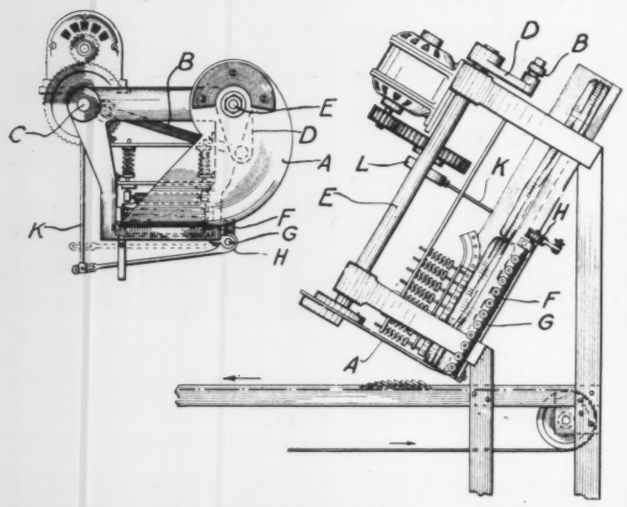


Fig. 2—Meat slicing machine provides for "draw-cutting" action and has positive adjustable feed mechanism

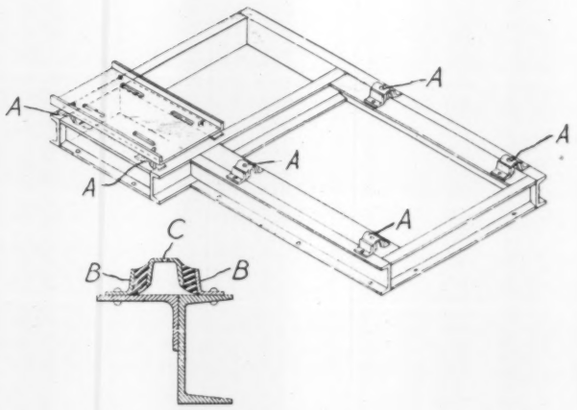


Fig. 3—Laminated shims are used at the ways and racks in printing press bed and hanger

junction with a continuously moving conveyor belt timed to carry the slices from the slicing point to the packing point in the overlapping formation in which they usually are boxed or wrapped.

PATENT No. 2,014,466, granted to Charles C. Cheyney of Buffalo, N. Y., and assigned to Buffalo Forge Co., covers means for cushioning and quieting machines such as centrifugal fans when mounted on prefabricated steel bases.

A typical base of the type involved is shown in *Fig.* 3, the small sub-base at the left-hand corner being that on which the drive motor is mounted. On the main base and under the sub-base can be seen the cushioning and quieting units *A*, of which an enlarged section is shown in the separate view.

The form of these elements recommended by the inventor comprises two interspaced angle irons *B* between which is mounted in rubber an inverted U-shaped member *C* provided with a hole for a bolt in the closed end. This assembly is vulcanized together and is fastened to the base by bolts or rivets through the bases of the angle irons.

Advantages claimed for this type of base are: it permits of quick erection and alignment of machinery without necessitating elaborate foundation preparation (it can be set flush by being sunk in concrete or can merely rest on a surface); the base can be designed to be "knocked down" for economical shipment if desirable; and transfer of noise or vibration to the floor and to nearby machinery is eliminated by the insulating effect of the "floating" elements.

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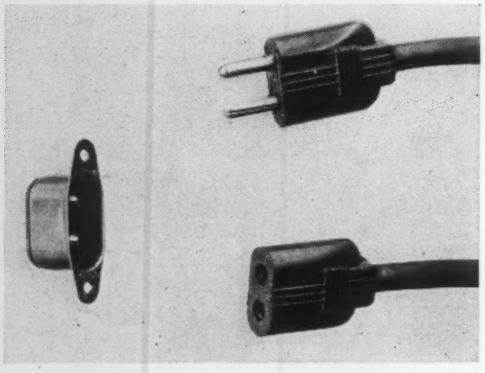
NEW Materials and Parts

Styled Accessories Are Announced

DEVELOPMENT of a new appliance connector and detachable cord set has been announced by the accessory sales department of General Electric Co., Bridgeport, Conn. The small metal receptacle, shown herewith, is designed for building into an appliance or



Appliance connector and cord sets are designed for building into machines

light electrical machine to permit a connection at the appliance. The receptacle is made so that it sets flush and does not project. A new all-rubber connector, designed for appearance, is available to complete the assembly.

An alternative combination is furnished by a matched all-rubber connector and plug, styled by an industrial designer, also shown herewith. The value of styling such accessories is evident when seen with the appliances they service. These all-rubber devices are molded into the cord in one piece.

Electrode Welds Low Chromium Steels

STEELS known as 4-6 per cent chromium steels, which are rapidly gaining acceptance in applications requiring resistance to crude oil corrosion at high temperatures and pressures, can now be successfully welded by use of a new electrode just announced by Lincoln Electric Co., Cleveland, Ohio. "Chromeweld 4-6" electrode permits full development of the valuable properties of the low-chromium steels. These steels possess a resistance to sulphide corrosion four to ten times that of ordinary steel and a resistance to oxidation at 1000 degrees Fahr., three times as great. The electrode contains the essential element of molybdenum and provides weld metal possessing the necessary high creep strength and other qualities essential for welding the steels. Such steels, welded with the elctrode can be soft annealed to physical properties similar to those of mild carbon steel, and therefore rendered suitable for equipment where severe cold working is applied during fabrication.

Nonreversing Linestarters Improved

A NEW line of De-ion nonreversing linestarters has recently been announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Available in four sizes ranging from 25 amperes to 150 amperes, they are used for across-the-line starting of squirrel-cage induction motors, and as primary switches for wound rotor induction motors. Typical applications include machine tools, textile machinery, pumps, fans and similar machines where control is desired from a pushbutton or other pilot device with complete protection to the operator, the motor and the machine.

These linestarters are compact in design. The De-ion

An arc quencher in these linestarters confines, divides and extinguishes the arc almost instantly

arc quencher confines, divides, and extinguishes the arc almost instantly without flash or scattering of flame, giving a high degree of safety. Vertical operation of the magnet prevents accidental closing of contacts due to mechanical shock or tilting. Motor protection is

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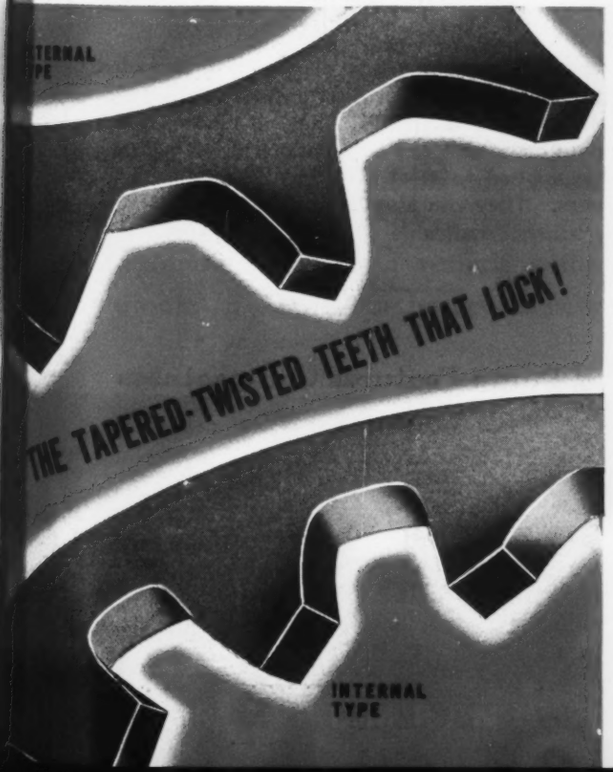


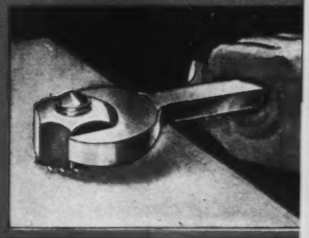
U. S. Patent Nos. 1,862,486 1,909,476 1,909,477 1,419,564 1,782,387 1,604,122 1,963,800
Other Patents.
Patents Pending.
Foreign Patents.

Free TEST RING

MAKE THIS CONVINCING 3-WAY TEST

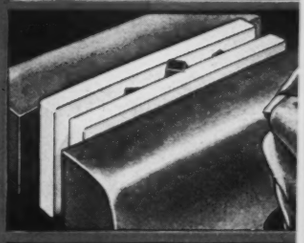
STRUT-ACTION

Turn a nut down tight against a Shakeproof Lock Washer—then loosen this nut and, as you push the wrench, feel the powerful resistance set up by the bite of the tapered-twisted teeth—that's Strut-Action!



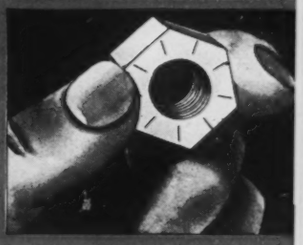
SPRING-TENSION

Place a Shakeproof Lock Washer between two pieces of ordinary steel and insert in the jaws of a vise. As you tighten the vise, watch the teeth bite in deeper—keeping the locking action constantly in force—that's Spring-Tension!



LINE-BITE

Examine a nut after it has been locked by a Shakeproof Lock Washer. The marks of the teeth prove Line-Bite!



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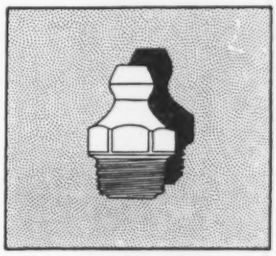
provided by a new bi-metal thermal overload relay.

Their appearance is distinctive with rounded corners and vertical lines on the cover. The contactor and overload relay are mounted on a steel panel with no back of panel wiring which makes the linestarters ideal for built-in applications. All parts and terminals are conveniently accessible from the front.

Announces Threaded Drive Fitting

AN HYDRAULIC threaded drive fitting which makes its own thread when it is driven into a ⅜-inch hole is a new development in high pressure lubrication announced by Alemite division, Stewart-Warner Corp., 1812 Diversey Parkway, Chicago. When this new fitting is driven into the hole drilled in the machinery part, a swedging action (similar to that of rolling an internal thread) takes place and causes the metal to flow.

If this fitting should ever be broken or otherwise damaged on a machine in service, it can be replaced by another of the same kind or any other ⅛-inch pipe thread fitting. The old fitting is simply unscrewed from the machine and the new one screwed into the threaded well created when the original installation was made.



Grease gun fitting makes its own thread when it is driven into a simple drilled hole

At present there are four types of Alemite threaded drive fittings: Model 1720 is a straight fitting; 1721, a 30-degree elbow; 1722, a 67½-degree elbow; 1723, a 90-degree elbow. All are cyanide hardened so that they can be applied to steel of up to 42 to 48 Rockwell hardness. They can also be applied to aluminum, aluminum alloys, malleable iron, steel castings and forgings.

Geared Pump Features Compactness

A BACK-GEARED unit on L-shaped base is being offered by the Viking Pump Co., Cedar Falls, Iowa, in its new figure 108 rotary pump. The unit features compactness in view of its extreme gear reduction. Pump speeds can be reduced to as low as 100 RPM from a standard 1750 RPM motor.

The gear box is totally enclosed with the gears op-

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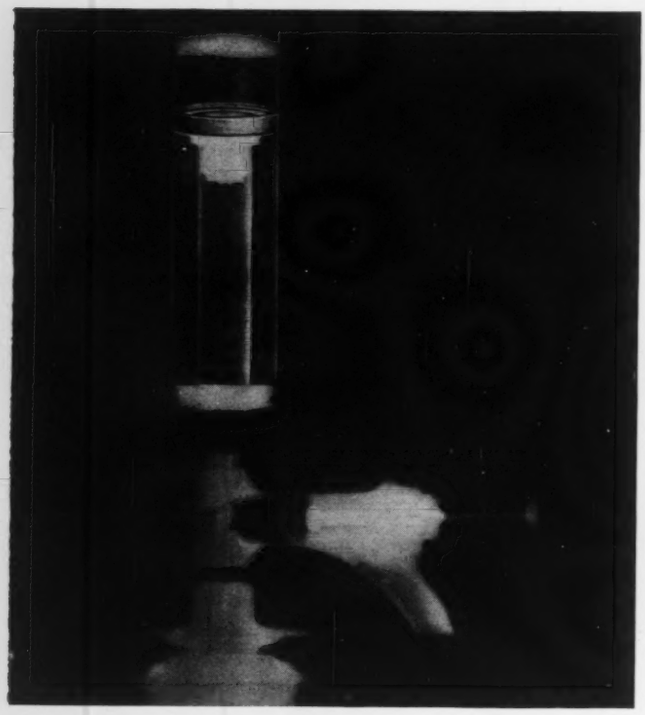

Whether the equipment you design is as simple as the pump whose X-ray photograph is pictured here, or a highly complicated machine—Graton & Knight packing engineers, with their X-ray thinking, are ready to help you design the packing that will do the perfect job for you.

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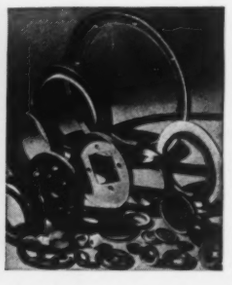
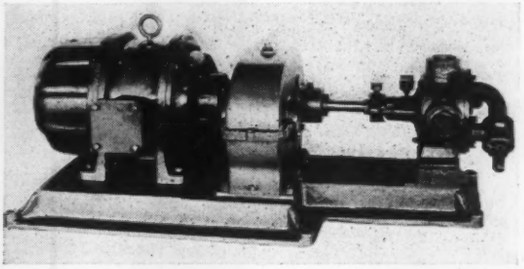


"Creating Success at the Packing Point"

erating in a bath of oil. On units using motors of 2 horsepower and above, reduction gears are made of steel. Standard equipment also includes an end-thrust bearing for the rotor shaft. This bearing is of the



Compactness is achieved in geared pump design despite extreme reduction supplied

flange mounting type bolting directly on to the cast iron gear box.

The complete unit makes a neat, quiet and clean pumping job for liquids of either light or heavy viscosities due to the flexibility in accommodating such extreme gear reductions without changing the overall dimensions of the gear box. The unit is available from the 20 GPM pump at 450 RPM to the 90 GPM pump at 390 RPM.

Redesigns Automatic Starters

ACCESSIBILITY for periodic inspection, arrangement of parts for quick replacement, vertical closing action and compactness are the four major features in the design of this new alternating current automatic starter of Square D Co., Milwaukee. Magnet as-

Parts of alternating current automatic starter are easily accessible for inspection or adjustment

sembly, stationary and moving contacts and the thermal relays are replaceable units, arranged so the assembly can be taken apart completely and reassembled in approximately ten minutes.

The starter is known as type T, class 8536. It is line-voltage type, can be used to start polyphase, squirrel-cage motors directly across the line, at full voltage where the application permits. Sizes in the present

Motors must be diversified to fit the varying requirements of machinery manufacturers and users. Misfits are costly. That's why the Wagner line includes all types of small motors generally applied to motor-driven machinery, making it possible for you to obtain the motor exactly suited for your job.

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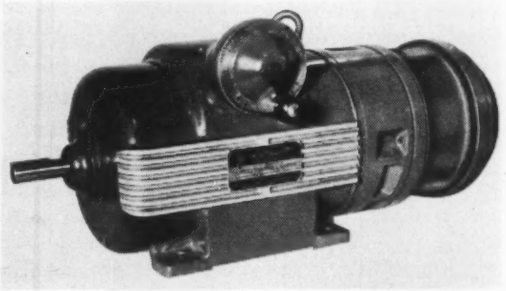
line include units for polyphase motors from 7½ HP at 110 volts to 25 HP at 440 volts, 550 volts, and 600 volts; units for single-phase motors from 3 HP at 110 volts to 7½ HP at 220 volts.

The double-break contacts are made of silver and the contact blocks are arranged for addition of auxiliary contacts for electrical interlocking or signal operation. The arc chambers are of the molded insulation with built-in arc suppressors. The magnet core and armature are Parkerized and the magnet is proportioned so it will seal at any voltage at which it will pick up. The movement in closing and opening is vertical for compact arrangement and to prevent mechanical shock from causing accidental closing. The thermal overload relays employ Nichrome resistance wire, are ratchet type, and contain an alloy that melts on a sustained overload to release a magnet-circuit opening latch.

Two or more push button stations, limit switches or other mechanisms can be used with one unit and motor. Two or more units can be interlocked electrically for sequence operation. Liquid level, pressure, heat regulating devices can be applied with the starter in automatic motor control.

Variable Transmission Is Unique

ONLY five major parts are employed in the new type of variable speed transmission recently placed on the market by Graham Transmissions, Springfield, Vt., which furnishes any desired output speed from half motor speed down to zero and reverse. Power for the unit, shown herewith, is commonly taken from a constant speed motor, the shaft of which is connected to

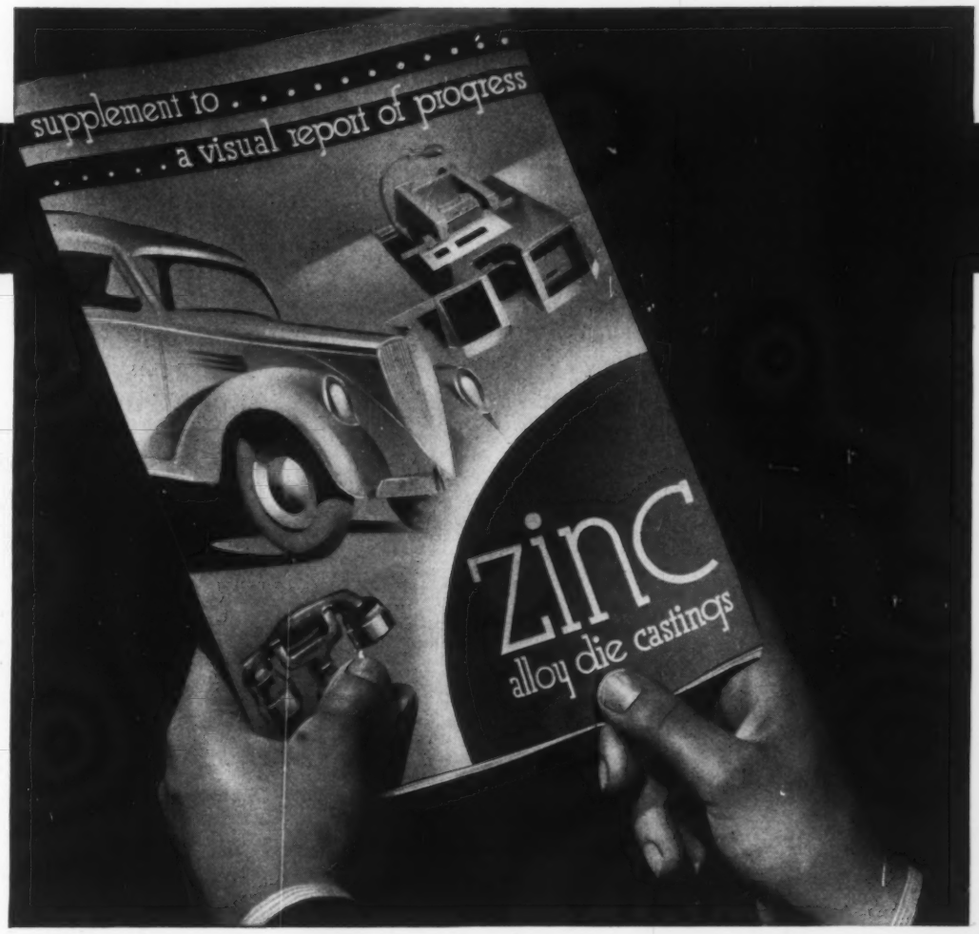


Infinite variable speed is provided by shifting the position of tapered rollers

a carrier which therefore rotates at motor speed. The carrier supports three taper rollers which are kept in intimate contact under pressure with a nonrotating ring and thus must turn at motor speed times the ratio of ring and roller diameters at the point of contact between them.

The three rollers carry planet pinions which mesh with an internal gear, the latter being connected to the output end, providing a step-down ratio combined with speed variation. The variation in speed is obtained by moving the nonrotating ring along the taper rollers and thus changing the diameter ratio of these two members. In this way, infinite speed range plus

New Jersey zinc



A NEW PROGRESS REPORT!

A year of amazing progress in die casting technique—die casting machines—die casting applications—has made possible this Supplement to last year's "A Visual Report of Progress."

This new book has thirty-two pages of photographs of the latest developments from eight different fields—many are so new production has only started and they will not be in actual service for several months. We feel that this "Supplement" will be of exceptional value to engineers, designers, production men—to anyone who is active in the development and fabrication of products incorporating metal parts. The designer of a new oil burner may be interested in a new die casting use, in a kitchen appliance, an automobile heater, a vending machine. The designer of metal toys may find a helpful suggestion in the section of Novelties, Radios, or Office Equipment. The book is a cross-section of die casting ideas.

We will be glad to send a copy of the "Supplement to A Visual Report of Progress" to anyone connected with the design, manufacture or sale of metal products. Also we still have a few copies of the original "A Visual Report of Progress" available for anyone who failed to receive a copy of this earlier book.

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Yes, I want a copy of your booklet on UNBRAKO Screws

Mr._____ Title_____

Firm_____

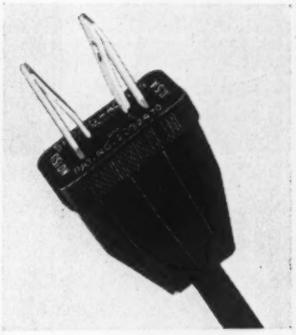
Address_____

reverse is combined in one unit.

The transmission is bidirectional, operating equally well in either direction of rotation. It can also be driven from the output end, where a slow-running shaft must supply power at variable speeds to a high-speed machine. The motor can be built-in as shown, or it may be connected to the transmission by a flexible coupling, motor and unit being retained on a common bed plate. The unit is so designed that a geared head can be incorporated at the output end without appreciably increasing the overall length. With this arrangement further reduction, or a top speed as high as twice motor speed can be obtained. Turning of a control wheel sets the ratio between input and output speeds.

Rubber Plugs Have Spring Blades

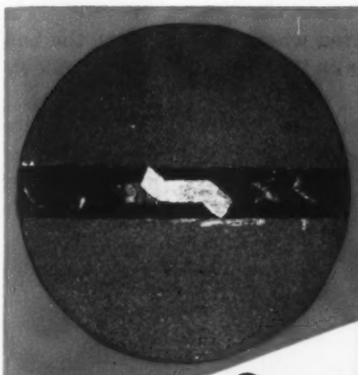
SPRING action blades, designed to insure positive contact at all times even in worn outlets, have been incorporated in the rubber plugs being offered by Allied Mercantile Co., 13 East Runyon street, Newark, N. J. The interior sections of the blades, shown in the accompanying illustration, provide the spring action to insure a snug fit in the outlet. The plugs are insulated with rubber throughout and the blades are locked into position. They are furnished in black, brown and ivory, and fit the new 5-way outlets.



Positive contact is assured with new plugs by the unique spring action of the blades

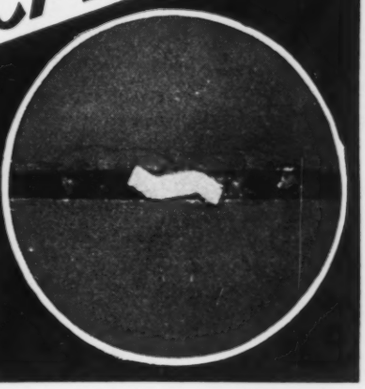
Introduces New Mill Type Starters

FOR providing a universal, compact, standardized unit suitable for use with a wide range of motor sizes and requiring only reconnection of the self-contained resistors to give proper resistor values, Electric Controller & Mfg. Co., 2683 East Seventy-ninth street, Cleveland, announces the new type RD direct current mill type starter. These starters, shown herewith, employ the new type RD mercury acceleration relays which permit a time range of ½ to 2 seconds per step. They are adjustable for this time range by means of an accessible thumb screw and lock nut arrangement which permits readily changing the amount of mercury

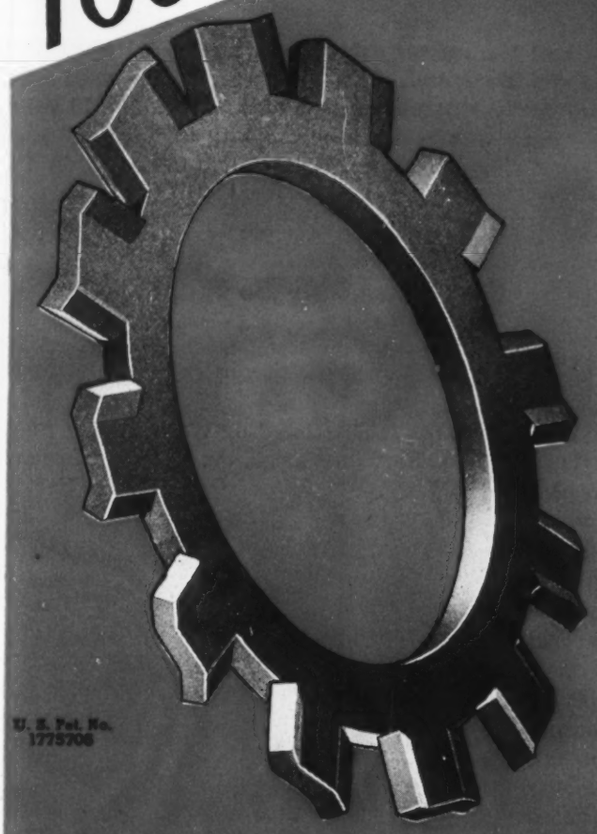


End view of Everlock tongue before nut is set down. Note that body of tongue is horizontal with only sharp projecting edges touching nut and work surfaces. *(Unretouched)*

YOU CAN'T FOOL THE CAMERA!



With nut set down. Note how body of tongue is flexed, setting up tremendous spring tension, and that the sharp projecting edges are forced into nut and work. *(Unretouched)*



U. S. Pat. No. 1775706

1 Die-formed teeth of Everlock Washer bite into both nut and work—keep nuts from loosening.

2 Powerful spring tension forces teeth in and holds connection firm.

3 Tongues retain shape in severest service—no flattening.

4 Nuts set down on Everlock Washers stay tight through years of service.

These *enlarged unretouched photographs* show clearly the dual action of Everlock Washer tongues that combines positive locking with powerful spring tension—keeps nuts locked and connections tight under severest vibration.

No wonder hundreds of manufacturers are turning to Everlocks on every lock washer application. Your own tests will quickly demonstrate the reason.

FREE SAMPLES for testing. Just write, specifying the sizes you want.

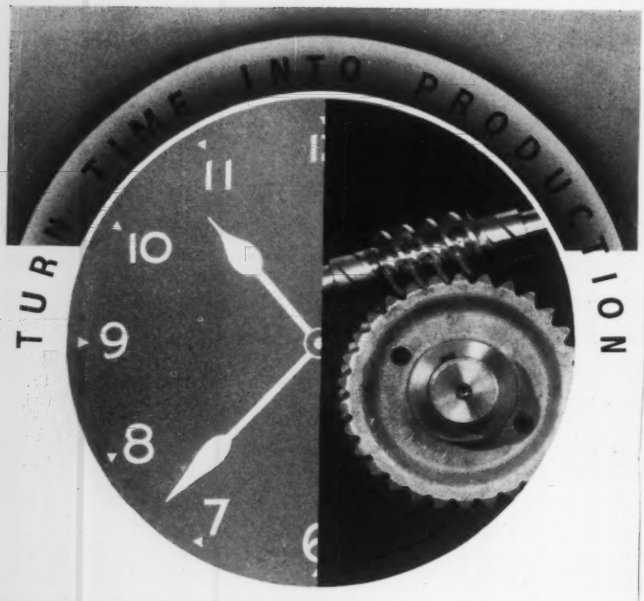
Everlock

Thompson-Bremer & Co.

1640 G W. Hubbard St. - - Chicago

Everlock

The Dual Action LOCK WASHER



A good workman is never a "clock-watcher." Clocks can only record passing time, while workers in a plant, whether men or machines, are valued according to their ability *to turn time into production.*

Whenever there are problems of power transmission, think of the faithful performance of Cleveland Worm Gear Drives and their ability to keep machines running year in and year out, without requiring mechanical servicing of their own.

Design Engineers on hundreds of different machines requiring Speed Reduction know by experience that they can trust "Clevelands" in any application for which they were designed.

Trained "Cleveland" District Representatives are available for consultation on your own problems, and will call at the time most convenient for you. The Cleveland Worm & Gear Co., 3275 East 80th Street, Cleveland, Ohio.

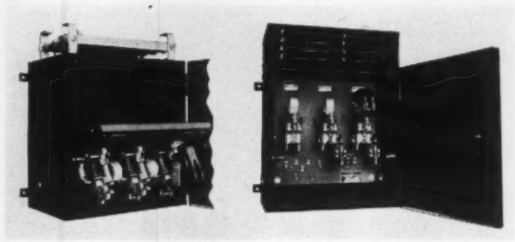
Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication

At that vital point, install Cleveland Worm Gear Drives

CLEVELAND *Worm Gear Drives*

through which the rubber disk must operate. The maximum time is secured when the disk is at the bottom and has to operate through the full volume of mercury.

A 3-coil, unbreakable resistor is mounted on the

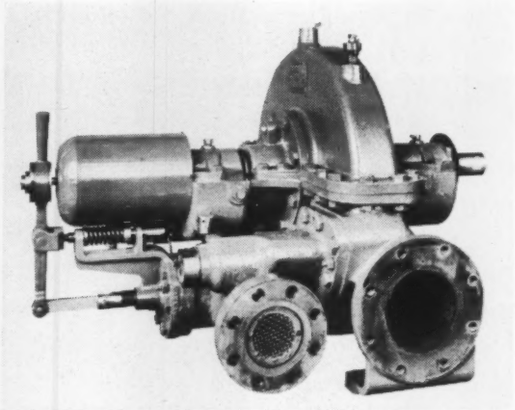


Mill type starters are adjustable to their time range by means of an accessible screw

top of the starter cabinet and is covered by a ventilated enclosure. These starters can be used with any motor within the range of 5 to 25 HP., 230 volts. They are also suitable for use with a range of horsepower sizes on 115 and 550 volt motors within the ampere rating of the contactor.

Turbines May Be Built In

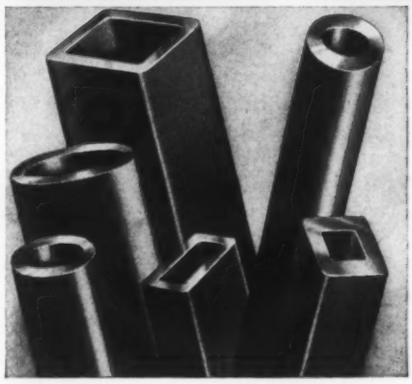
FOR driving general purpose machinery in industrial plants and auxiliary equipment in generating stations and on shipboard, a new and improved line of type "C" turbines is announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The turbines are



Impulse type turbines can be included as integral parts of larger machines

of the impulse type having one pressure and two velocity stages. They are built in capacities ranging approximately from 5 to 500 horsepower, at turbine speeds of 1000 to 5000 RPM. Suitable for use with steam pressures up to 650 pounds gage and for total temperatures up to 750 degrees Fahr., they may be operated either condensing or non-condensing with rotation in either direction. These turbines are particularly adapted to

TWO HEADS are *better* than ONE



SHELBY
***Mechanical* TUBING**

WHAT do you want in the 'parts' you make? — economical production . . . improved performance . . . finer appearance . . . larger sales? All right, let's get together.

Call in a NATIONAL TUBE engineer, a specialist in seamless mechanical tubing. Working with your production engineers and designers he may uncover savings in fabrication, suggest possible improvements in design that can easily be overlooked. For he brings to you the accumulated experience of hundreds of technicians, metallurgists and production men, who have devoted years of time, energy and talents to the development and practical application of seamless tubing for its many needs.

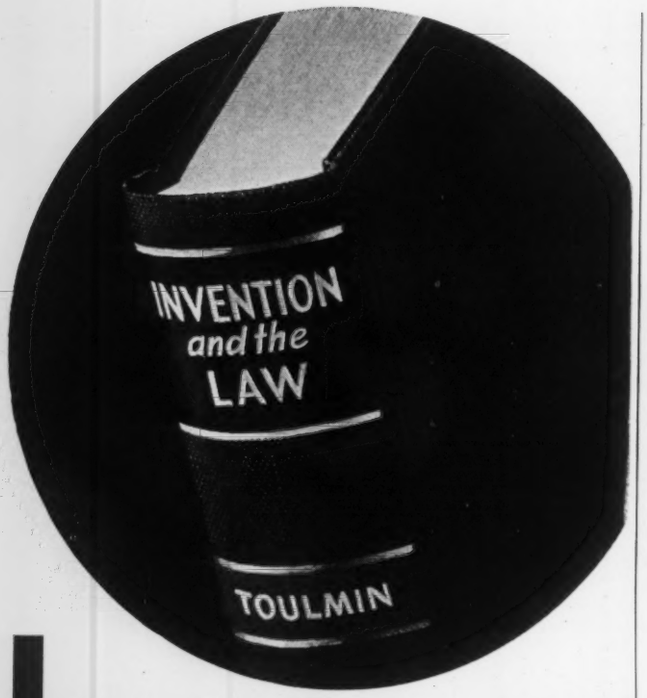
Let him show you how this versatile material can be best applied to improve your product. Let him explain the easy fabricating quality of SHELBY Seamless Tubing—its ability to minimize grinding and machining operations — to cut tool costs — to reduce labor in an almost endless number of fabrications that are essentially tubular in character. He can tell you why SHELBY Seamless Tubing is always uniform both in its fabricating qualities and the results it gives in service. His cooperation on your problem costs you nothing, puts you under no obligation. Why not call him in.

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL



INVENTION and the LAW

Harry Aubrey Toulmin, Jr.

J. D., Litt. D., LL. D.
Member A. S. M. E., Franklin Institute, S. A. E., etc.

HERE is a much-needed, practical manual on patentable invention for the use of engineers and executives, as well as for attorneys, by a writer experienced in this field. It is a complete desk manual on how to determine invention.

What is Design that is not Invention? What is Invention? This new book enables you to find quickly a clear and understandable statement of the RULES on each invention question. These rules are based upon decisions of the Supreme Court of the United States. They are accurately stated in simple and understandable language for engineers and executives.

This book answers questions as to how invention is determined; explains invention rules in other countries; what you must do to determine the patentability of inventions. It contains exhaustive indexes of every rule involving invention with a complete list of books and magazine articles in English, French and German on invention.

You may order *Invention and the Law* for five days free approval. At the end of that time, return the book to us, or remit $5.00. 347 Pages, 6 x 9 inches.

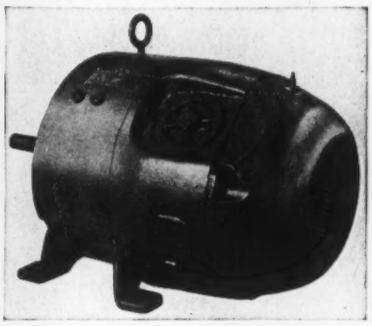
PRENTICE-HALL, Inc.
Dept. IP-19 70 Fifth Ave.
New York, N. Y.

driving pumps, forced and induced draft fans, compressors, Jordans, pulp beaters, pulverizers, line shafts, and similar apparatus; either direct connected or through gear or belt drive.

Develops Explosion Proof Motors

EXPLOSION-PROOF, fan-cooled, direct current motors in new and improved totally-enclosed types have been made available by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Available in sizes from five to seventy-five horsepower and 115, 230 and 550 volts the motors, shown herewith, are designed for use in locations where explosive gases or dust may exist.

Brushes and commutator are readily accessible and the motor is designed with the fan on the commutator and so that a gear case, coupling, or pulley will not restrict ventilation. Accessibility is obtained by the use of a double walled bracket on the commutation end. This bracket is equipped with hand hole covers which are readily removable to permit inspection and adjustment of the brushes and commutators.



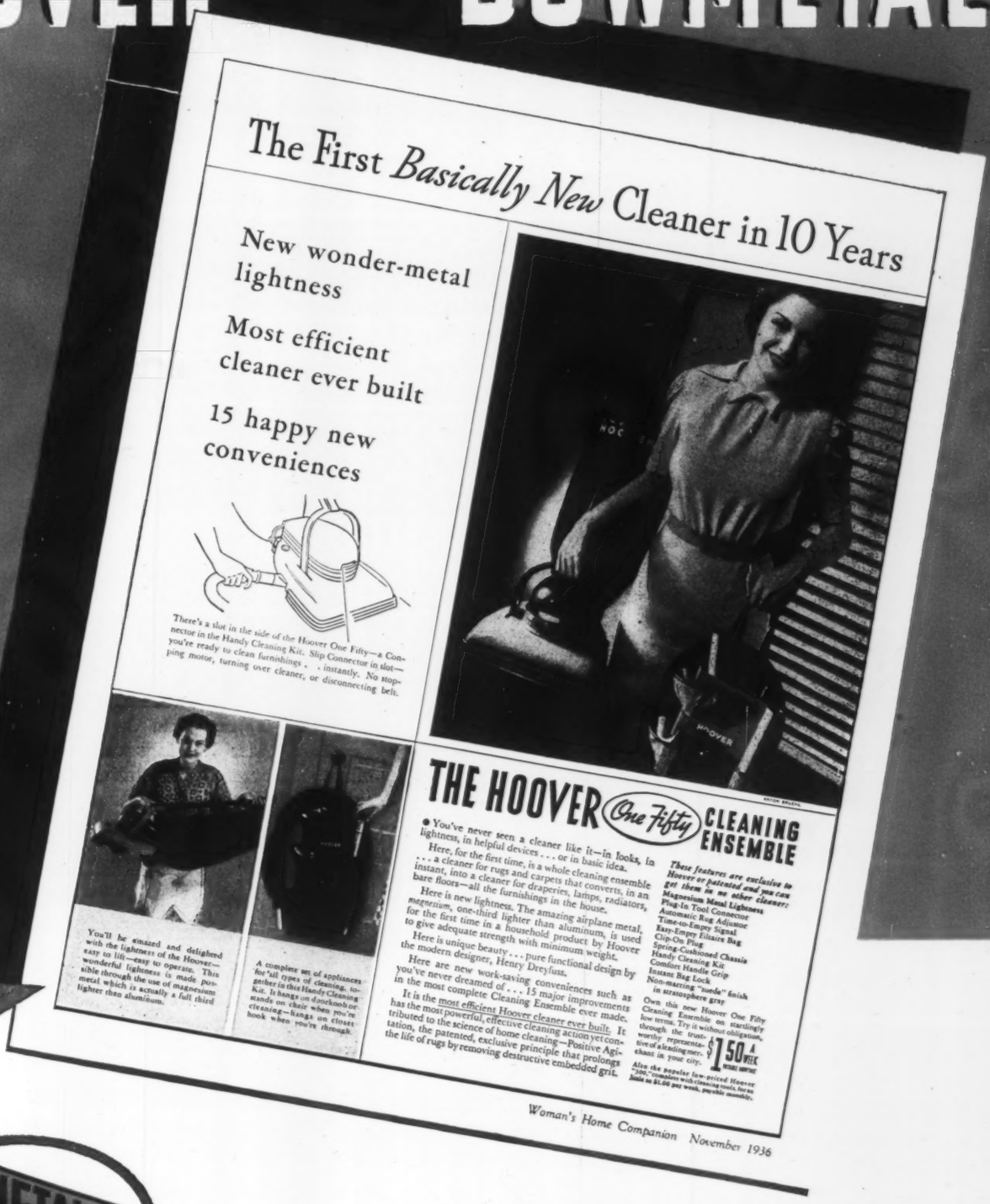
Motor is designed with fan on the commutator so that other parts will not restrict ventilation

The presence of a fan on the commutator end forcing a large volume of cooling air through properly located air passages makes possible high continuous capacity with minimum size. Due to the unique design of the double walled bracket, mounting the fan on the commutator end is accomplished without interfering in any way with the accessibility to the brushes and commutator. Fans mounted on the shaft extension end are objectionable because they impose undue stress on shaft and bearings due to the increased distance between the point of application of load and the bearing, and because pulleys, belts, gear cases, etc., restrict the flow of air to fan.

Bronze Bushings Are Prelubricated

FOR installations requiring a predetermined lubrication life or centralized lubrication control, four types of oil reservoir graphite bronze bushings have been developed by Randall Graphite Products Corp., 611 West Lake street, Chicago. The bushings supply

HOOVER *adopts* DOWMETAL


The First *Basically New* Cleaner in 10 Years

New wonder-metal lightness

Most efficient cleaner ever built

15 happy new conveniences

There's a slot in the side of the Hoover One Fifty—a Connector in the Handy Cleaning Kit. Slip Connector in slot—you're ready to clean furnishings . . . instantly. No stopping motor, turning over cleaner, or disconnecting belt.

You'll be amazed and delighted with the lightness of the Hoover—easy to lift—easy to operate. This wonderful lightness is made possible through the use of magnesium metal which is actually a full third lighter than aluminum.

A complete set of appliances for all types of cleaning, together in this Handy Cleaning Kit. It hangs on doorknob or stands on chair when you're cleaning—hangs on closet hook when you're through.

THE HOOVER *One Fifty* CLEANING ENSEMBLE

● You've never seen a cleaner like it—in looks, in lightness, in helpful devices . . . or in basic idea.

Here, for the first time, is a whole cleaning ensemble . . . a cleaner for rugs and carpets that converts, in an instant, into a cleaner for draperies, lamps, radiators, bare floors—all the furnishings in the house.

Here is new lightness. The amazing airplane metal, *magnesium*, one-third lighter than aluminum, is used for the first time in a household product by Hoover to give adequate strength with minimum weight.

Here is unique beauty . . . pure functional design by the modern designer, Henry Dreyfuss.

Here are new work-saving conveniences such as you've never dreamed of . . . 15 major improvements in the most complete Cleaning Ensemble ever made.

It is the most efficient Hoover cleaner ever built. It has the most powerful, effective cleaning action yet contributed to the science of home cleaning—Positive Agitation, the patented, exclusive principle that prolongs the life of rugs by removing destructive embedded grit.

These features are exclusive to Hoover or patented and you can get them in no other cleaner:

Magnesium Metal Lightness
Plug-In Tool Connector
Automatic Rug Adjustor
Time-to-Empty Signal
Easy-Empty Filtaire Bag
Clip-On Plug
Spring-Cushioned Chassis
Handy Cleaning Kit
Comfort Handle Grip
Instant Bag Lock
Non-marring "suede" finish in stratosphere gray

Own this new Hoover One Fifty Cleaning Ensemble on startlingly low terms. Try it without obligation, through the trustworthy representative of a leading merchant in your city.

$1.50 A WEEK

Also the popular low-priced Hoover "300," complete with cleaning tools, for as little as $1.00 per week, payable monthly.

Woman's Home Companion November 1936

DOWMETAL

MAGNESIUM ALLOYS
LIGHTEST OF ALL STRUCTURAL ALLOYS

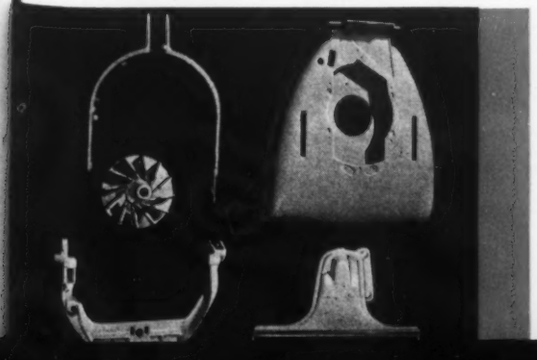
IN the new Hoover—just announced—Hoover designing engineers have surpassed all their previous accomplishments in design, performance and convenience.

First among its features is amazing *lightness*—made possible through the adoption of Dowmetal (magnesium alloys).

Being a full third lighter than aluminum, yet possessing exceptional toughness, strength, and durability, Dowmetal enabled Hoover designing engineers to achieve the optimum in lightness without the slightest sacrifice in that rugged dependability which has made Hoover a first, and lasting choice in millions of homes.

In its adoption of Dowmetal, Hoover joins with a large body of manufacturers benefiting from the economic and sales advantages of products made lighter.

THE DOW CHEMICAL COMPANY · *Dowmetal Division* · Midland, Michigan



At the left are shown the five different DOWMETAL parts used in the new 150 Hoover electric cleaner. Their combined daily production totals approximately 5000 die-castings.

DESIGN ON PARADE

Through the centuries design has moved forward. Often hated, frequently fought, design progress could not be stopped.

Today the tempo has quickened. The parade doesn't wait for laggards!

This parade is pictured in the pages of *Machine Design*. Every article is a record of progress from which the design engineer can adapt ideas to his own problems.

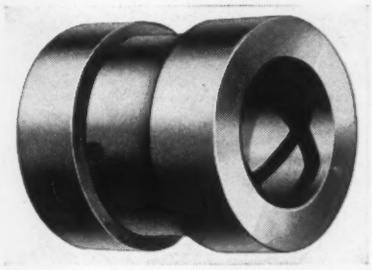
From the more than 6200 manufacturers of machines, from the thousands of makers of parts, materials and process equipment, from practicing engineers and the laboratory, the latest developments are brought to your attention.

Short, pertinent design topics are covered each month under the heading "Scanning the Field for Ideas."

Watch for these developments!

automatic lubrication control by feeding lubricant from the reservoir through graphite plugs which regulate the rate of flow. Additional positive lubrication is supplied by graphite in machined grooves on the bearing surfaces.

Two of the bushings provide their own reservoir space by undercuts on the outside walls. Of these, one is designed for high speed installations or for intermittent use where lubrication is supplied only during assembly of the product or at long intervals. The other is designed for installations such as automotive



Lubrication is fed from the reservoir through graphite plugs in these bearings

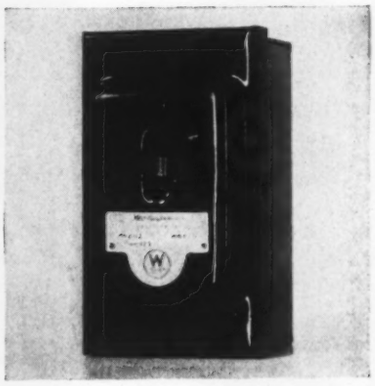
water pumps and has lubrication for both bore and flange supplied through graphite feed plugs and graphite-filled grooves.

The other two bushings are designed for applications where the oil reservoir is provided in the bearing housing. These bushings are also lubricated through graphing both the bore and the face of the flange.

All of these bushings can be reamed, broached or diamond bored after installation without damaging the graphite. Neither oil nor water will wash out the graphite or cause it to recede below the surfaces.

New Switches Are Small in Size

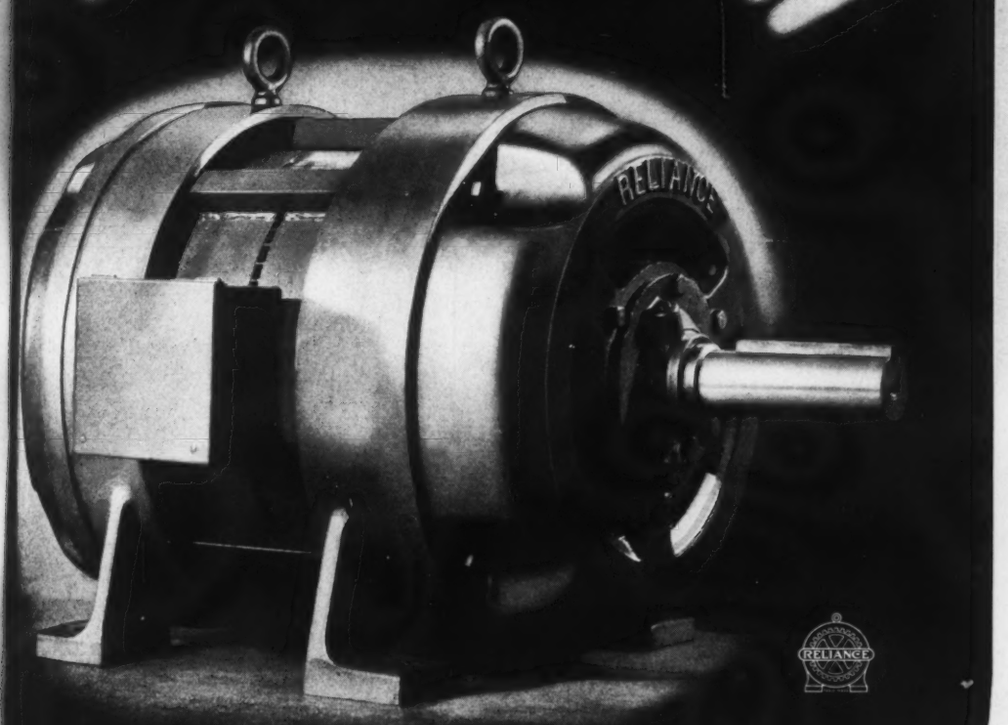
FOR use on oil burners and other applications where midget switches are advantageous, a new line of front operable general purpose type D safety



Compact switches are designed for location in places where side operating switches cannot be used

switches have been announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The switches are extremely small in size, sturdy in construction and

STEEL FOR STRENGTH

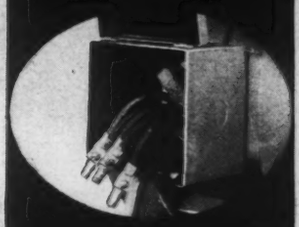


Squirrel-cage Reliance Induction Motor with Bail Bearings
(Type "AA", Open-slot Frames 444—585)

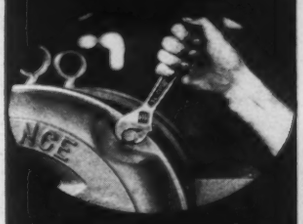
STRENGTH INDEED! An all-steel frame to start with, as essential to a motor as good, healthy bone structure to the body. Supplemented by husky bearing brackets, shafts, bearings and other "organs." Altogether, a rugged, long-lived unit of equipment that cares not how *heavy* your heavy-duty service may be. That's the Reliance Type "AA" Motor all over . . . An organization committed to lengthening motor life by incorporating every endurance feature . . . An adequate, trained force ready to hop on your job personally—and with dispatch . . . Weigh these features when considering sources of supply.

RELIANCE ELECTRIC & ENGINEERING COMPANY
1088 IVANHOE ROAD CLEVELAND, OHIO

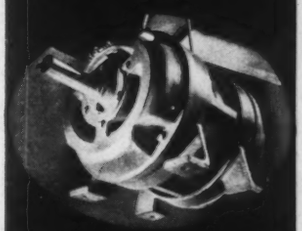
Branches: Boston, Buffalo, Chicago, Cincinnati, Detroit, Greenville (S. C.), New York, Philadelphia, Pittsburgh. *Representatives in other principal cities*



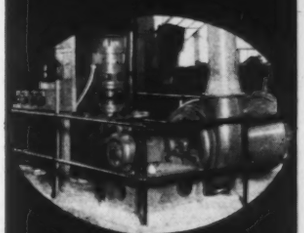
There's a lot of room for making connections in the conduit outlet box. Conduit can be brought in from the top, bottom or either side.



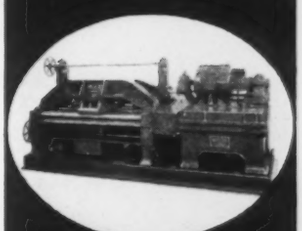
The wrenches commonly used for maintenance work will reach all bolt heads.



The bottoms of the cast-steel feet are finished and base holes are jig-drilled.

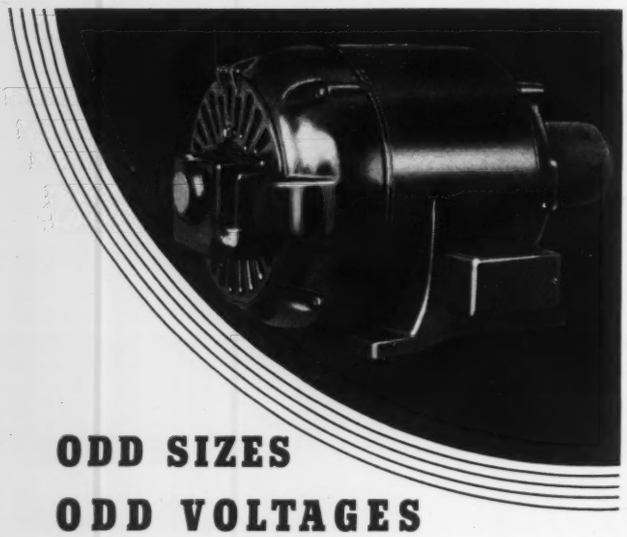


Vertical Type "AA" Motor driving Whiting Coal Pulverizer on malleable iron melting furnace. Horizontal motor on exhauster.



A 4-speed squirrel-cage motor drives pinch rolls and levellers on this Budd-McKay Sheet Processing Machine. A special-torque motor is used for quick movement of processing roll.

RELIANCE A-C D-C MOTORS



ODD SIZES
ODD VOLTAGES
ODD FREQUENCIES

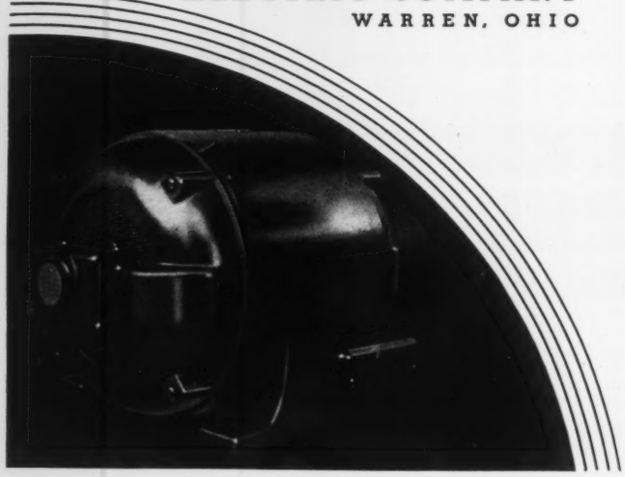
Delivered Promptly

● Stock motors are easy to secure, but when you want special designs or odd current characteristics, you will find that Peerless can start from scratch and build the complete motor in less time than it takes many to get under way.

This can be done because Peerless has the advantages of the moderately small manufacturer but is large enough to take care of all requirements promptly.

Peerless also stocks *standard* motors. If you are interested in a worthwhile proposition on motors "That have what it takes," write for further information.

The Peerless
ELECTRIC COMPANY
WARREN, OHIO

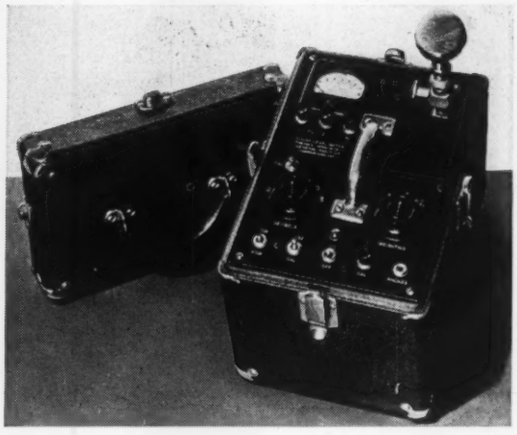


pleasing in appearance. Front operation and compact design make their use possible in many places where side operating switches cannot be used. They are available in two pole NEC and plug fuse types, also two and three pole solid neutral. Terminals and fuses are easily accessible and ample wiring space is provided. The cover may be sealed and provisions are made for locking switch in "off" position.

Engineering Department Equipment

Sound Meter Covers Wide Range

SOUND level meters type 759-A designed to meet the widest possible range of applications in the general field of sound-level measurement, have been introduced by General Radio Co., 30 State Street, Cambridge, Mass. Performance characteristics are based on the specifications recently adopted by the American Standards association. The sound intensity range cov-



Performance characteristics of sound meters are based on standard specifications

ered by this meter is from 24 to 130 decibels above the standard reference level of 10-16 watts per square centimeter at 1000 cycles. The microphone is nondirectional and can be used with an extension cord and tripod, if desired.

The calibration is highly stable, and provision is made for recalibration by a simple method. All three frequency-weighing networks accepted by the A.S.A. are included. Power requirements are small, and batteries are self-contained. Mechanically, the meter is rugged, light in weight, easily portable and attractive in appearance. Provision is made for the use of accessories, such as a vibration pickup.

The Portland, Ore., office of Chain Belt Co., Milwaukee, has been moved to 112-118 Southwest First avenue. This new location will enable the office to carry larger stocks and better serve the territory.

EVEN IN THE MOVIES

NICKEL PLAYS THE HEAVY RÔLE

. . . Helps the Caterpillar Tractors roll through strenuous stunts for JOE E. BROWN

Caterpillar tractor crashing through a fence and hurdling a car, as part of a wild-cat ride in the film "Earthworm Tractors."

Joe E. Brown at the controls. The combination of a fool salesman (Brown's rôle) and a heavy swamp provided cruel treatment for the tractor.

● No farmer in rocky hills, no construction gang, has ever put tractors through such a succession of stresses, bumps and jolts as the Caterpillar Diesel tractors had to take in the recent Warner Brothers' film, "Earthworm Tractors."

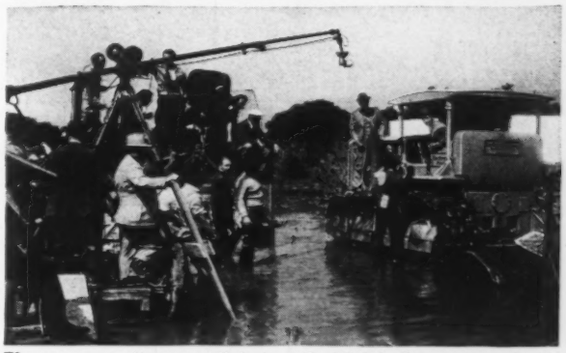
All tractors in the film are Caterpillar Diesels, taken from stock. The plot called for action: one of the mildest stunts the "star" tractor did was hurdle an automobile.

That the tractors came through all these jolts, surprised no engineer who knows the way Caterpillar builds machines. Quality materials for every part is their policy.

Caterpillar used about ten million pounds of Nickel alloys in 1935. Much of this is S.A.E. 2345, 3½% Nickel steel, which goes into the highly stressed gears and bolts. Cylinder heads and liners, piston rings, and starting engine crankshafts are made from Nickel Cast Iron.

For that extra resistance to fatigue and stress which all Diesels demand, engineers are turning more and more to alloys of Nickel. Find out where you can step-up the strength and dependability of your Diesel engines, by describing your special needs to Inco's technical staff.

NICKEL STEELS AND CAST IRONS



The camera can't very well feature the Nickel alloy gears and cylinder heads. They're out of sight,—but they help the "Caterpillar" laugh off punishment in every day rough work.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

DOWMETAL

—Strong enough for Trucks . . . . . Light enough for Airplanes

RID a workman of the weight in his tools and he'll have more energy to give to the actual job. Reduce the weight in trucks and similar vehicles, and running costs will be materially reduced.

These examples of cutting costs through the adoption of Dowmetal could go on indefinitely, for the utilization of Dowmetal, one-third lighter than aluminum, knows few limits. So, wherever utmost strength and durability is essential, and extreme lightness an asset or prime requisite, specify Dowmetal castings by Wellman.

● Castings ● Plated Parts ● Machined Parts
● Bent Tubes

Licensed to cast in Dowmetal and Ampco Bronzes

The WELLMAN
Bronze and Aluminum Co.

5900 Superior Avenue Cleveland, Ohio

MEETINGS *and* EXPOSITIONS

CORROSION resistant metals in design of machinery and equipment are to be presented in a most complete and usable symposium at the annual meeting of American Society of Mechanical Engineers at New York, Nov. 30-Dec. 4 * * * Designing engineers, constantly confronted with many problems of corrosion, expressed the need for such a symposium * * * The information is to be in compact form, of a practical nature, and so complete that the papers will form a handy reference for the engineer * * * Dr. Speller is to give an introduction to corrosion resistant metals . . . . Alloys of aluminum will be discussed by E. H. Dix Jr. . . . . F. L. LaQue is to present nickel and nickel-base alloys . . . . Zinc in the chemical industries will be the subject of E. A. Anderson while Dr. H. L. Maxwell will discuss cast iron in chemical equipment . . . . R. A. Wilkins will give the place of copper and copper-base alloys and G. O. Hiers will perform the same service for lead . . . . Completing the picture, J. H. Critchett will present corrosion resistant steel of the stainless type.

Another extremely important meeting from the standpoint of the design engineer will be the International Acetylene association gathering at St. Louis, Nov. 18-20 * * * Here the designer will have available latest information on oxyacetylene welding and cutting in all its variations * * * One of the most important sessions will be the welding and cutting forum . . . . Speakers are to present design and production information in detail . . . . Demonstrations will cover the materials used in the oxyacetylene process, gas welding, torch cutting, and the testing of welds and welded structures * * * The technical sessions are to include many other points of interest to the designer . . . . R. G. LeTourneau is to talk on shape cutting in heavy-duty dirt equipment . . . . Welding in the mining industry will be the subject of H. R. Wass and of G. Stuart Jenkins . . . . Round tables will cover codes and welding design construction, nonferrous metals and their welding characteristics, and similar topics.

Nov. 11-18—

National Automobile Show. Annual exhibition of new models to be held at Grand Central Palace, New York.

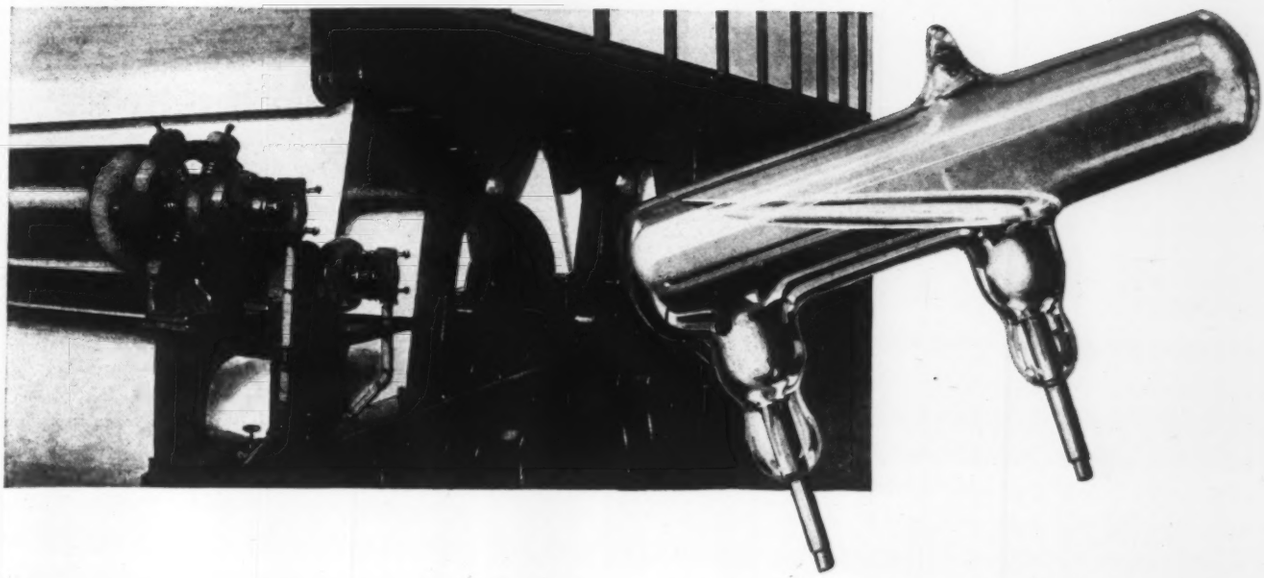
Nov. 18-20—

International Acetylene association. Thirty-seventh annual meeting to be held at Jefferson hotel, St. Louis. H. F. Reinhard, 30 East Forty-second street, New York, is secretary.

Nov. 30-Dec. 3—

American Society of Agricultural Engineers. Winter

"OUR KON-NEC-TOR MERCURY SWITCHES RESPOND TO THE SLIGHTEST TOUCH"



"We make machines for drying fabrics and paper. These machines involve a great many moving parts of mechanism which are so complex that there is constant danger of something going wrong. We depend on General Electric Kon-nec-tors to protect our machines against accidents. Kon-nec-tors watch over no less than six different operations in the dryer and are ready to stop the machine instantly if any one of these operations ceases to be performed properly."

Kon-nec-tors are protecting the machinery of manufacturers in nearly every branch of industry in ever-increasing numbers. Being wholly glass-enclosed, these switches are unaffected by corrosive gases. Contact is always clean and positive. They are extremely sensitive and respond to the slightest touch. They furnish absolute protection against sparking, are forever maintenance-free, and last indefinitely.

Write for complete details on how these modern switches can be incorporated in your own design. General Electric Vapor Lamp Company, 825 Adams Street, Hoboken, New Jersey.

GENERAL ELECTRIC VAPOR LAMP COMPANY

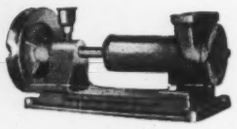
748K

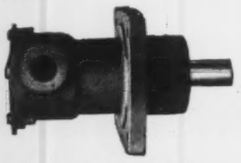
DESIGNED FOR *Simplicity*

BUILT FOR *Durability*

Viking Standard Pumps

For handling any grit-free liquid of any viscosity from water to molasses . . with efficiency and economy . . use the Viking Rotary Pump. "Just Two Moving Parts." Capacities from 1/5 to 1,050 G.P.M. Electric motor, belt or gas engine drive.



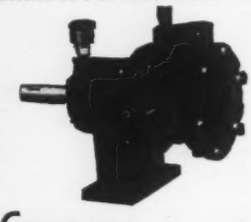


Hydraulic

For the actuation of machine tool movements and the operation of hydraulic lifts and elevators use the Viking Hydraulic Oil Pump. Made of laboratory-tested metals in capacities of 5 to 200 G.P.M.

Coolant Pumps

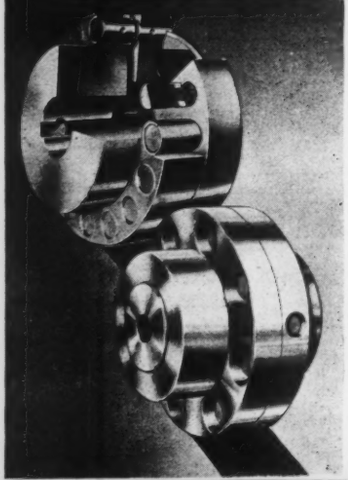
For machine tool cooling purposes use the Viking Coolant Pump. Capacities of 5, 10, 15, 20 and 35 G.P.M. Ports are tapped and plugged to permit changing the direction of rotation . . 4 position casing mounting. Built-in relief rotor to act as relief valve when the oil line is shut off.



Viking Pump Company
Cedar Falls, Iowa

VIKING ROTARY PUMPS

WALDRON
Flexible Couplings
A TYPE AND SIZE FOR EVERY PURPOSE



In designing drives to be subject to shock loads or vibration, you can provide utmost protection from the complete line of reliable Waldron Steel Couplings—a type for every purpose.

FRANCKE STANDARD
FRANCKE MARINE
GEAR TYPE
(MEDIUM DUTY)
GEAR TYPE
(HEAVY DUTY)
SPECIALS

Specification details will be supplied on request.

JOHN WALDRON CORP.
NEW BRUNSWICK · NEW JERSEY

meeting to be held at Stevens hotel, Chicago. Raymond Olney, St. Joseph, Mich., is secretary.

Nov. 30-Dec. 4—

American Society of Mechanical Engineers. Annual meeting to be held at Engineering Societies building. New York. C. E. Davies, 29 West Thirty-ninth street, New York, is secretary.

Nov. 30-Dec. 5—

National Exposition of Power and Mechanical Engineering. Exhibition of machinery, parts and materials to be held at Grand Central Palace, New York. Information on the exposition may be secured from the management at Grand Central Palace.

Dec. 2-4—

American Society of Refrigerating Engineers. Annual meeting to be held at Hotel Pennsylvania, New York. David L. Fiske, 37 West Thirty-ninth street, New York, is secretary.

Dec. 5—

Society for the Promotion of Engineering Education. Fall meeting of the Middle Atlantic section at Columbia university, New York. Prof. Frank L. Eidmann is chairman of this section.

Dec. 7-8—

Motor and Equipment Wholesalers association. Annual meeting and automotive industries show to be held at Stevens hotel and Navy pier, Chicago. B. W. Ruark, 400 West Madison street, Chicago, is general manager.

Jan. 7-11—

American Engineering council. Annual meeting to be held in Washington. F. M. Feiker, 744 Jackson Place, N.W., Washington, is secretary.

Jan. 11-15—

Society of Automotive Engineers. Annual meeting to be held at Book-Cadillac hotel, Detroit. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary.

Jan. 11-16—

American Road Builders association. Annual meeting and exhibition of machinery to be held at New Orleans. Charles M. Upham, 952 National Press building, Washington, is secretary.

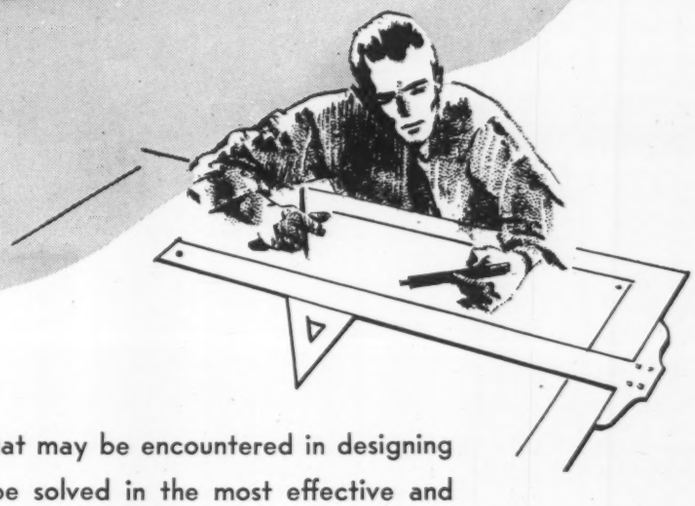
Jan. 25-27—

American Society of Heating and Ventilating Engineers. Annual meeting to be held at Hotel Statler, St. Louis. A. V. Hutchinson, 51 Madison avenue, New York, is secretary.

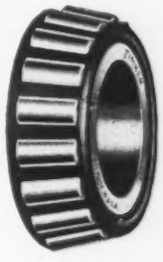
Feb. 14-19—

National Electrical Manufacturers association. Midwinter meeting to be held at Waldorf-Astoria hotel, New York. W. J. Donald, 155 East Forty-fourth street, New York, is managing director.

IS IT A TOUGH JOB? LAY IN TIMKEN BEARINGS



Any bearing problem that may be encountered in designing modern machines can be solved in the most effective and economical manner with Timken Bearings.



The Timken Bearing needs no auxiliary thrust carrying devices, having capacity built-in for radial, thrust and combined loads. Furthermore, it has the advantage of greater load capacity than other types of bearings, size for size, thereby saving space without reducing the factor of safety.

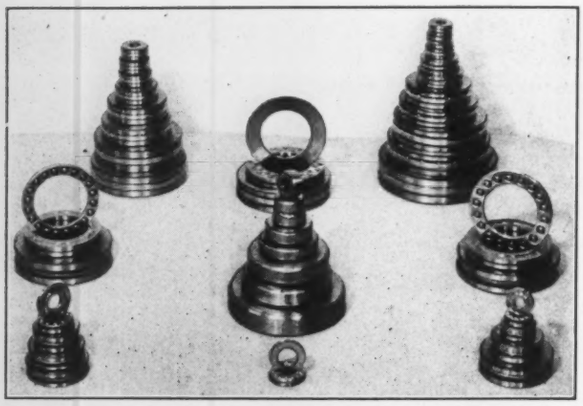
Whether your problem is speed, precision, load carrying, alignment preservation or any combination of these, the exclusive combination of Timken tapered construction, Timken positively aligned rolls and Timken Alloy Steel will meet every requirement in the same dependable way.

Timken engineers are always ready to cooperate in applying Timken Bearings whenever their assistance may be required.

One of the 8 Burlington "Zephyr" Streamlined Trains Equipped with Timken Bearings.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *TAPERED ROLLER* **BEARINGS**

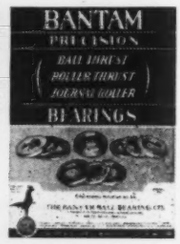


SUCCESS OF YOUR PRODUCT
. . . . OUR PRINCIPAL CONCERN

The sincere interest of our organization in the successful operation of its customers mechanical developments is what has caused industry to more and more prefer Bantam Ball and Roller Bearings.

Of course, this interest had to be backed up by the ability to solve the bearing problem and in many cases do what others had not been able to accomplish. That, for instance, is why 95% of the automobiles built use Bantam Roller Bearings. Also why practically all Diesel Motors use them.

Every designing engineer in the country should have a copy of our new catalog. It shows a comprehensive picture of the bearings which are saving money for manufacturers of small and large machinery. Send TODAY!



THE BANTAM BALL BEARING CO.
SOUTH BEND, IND.

BBB TAKE YOUR TOUGHEST BEARING JOB TO BANTAM

And NOW It's Up To YOU!

Here is your opportunity to become a leader in the field of your own specialization.

Our home study course on the "Theory and Technique of Inventive Practice" has been revised, greatly enlarged, and improved by the incorporation of results from past experience and teaching. It is modern in methods of instruction and the terms have been made easy for you.

We are ready to help you toward your life's ambition, "NOW IT IS UP TO YOU." Write today for your copy of our new illustrated catalog.

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Please send me, without obligation, your catalog "3-11."

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MANUFACTURERS' PUBLICATIONS

ALLOYS (COPPER) — Comprehensive and authoritative information about the commercially more important wrought copper alloys, that is, the ones that comprise the great bulk of everyday needs of industry, is given in a new booklet recently prepared by Chase Brass & Copper Co., Waterbury, Conn. Tabular matter, covering coppers, brasses, lead bearing brasses, tin bronzes and others, gives not only the more important physical and mechanical properties, but also data on working, welding and machining of these alloys.

ALLOYS (NICKEL)—International Nickel Co. Inc., 67 Wall street, New York, has issued a bulletin, No. U-1, "Automotive Uses of Nickel Alloy Steels," which gives information on the nickel alloy steels used in automotive construction. Problems solved by automotive engineers, being in many cases similar to those encountered in other industries, will be of interest.

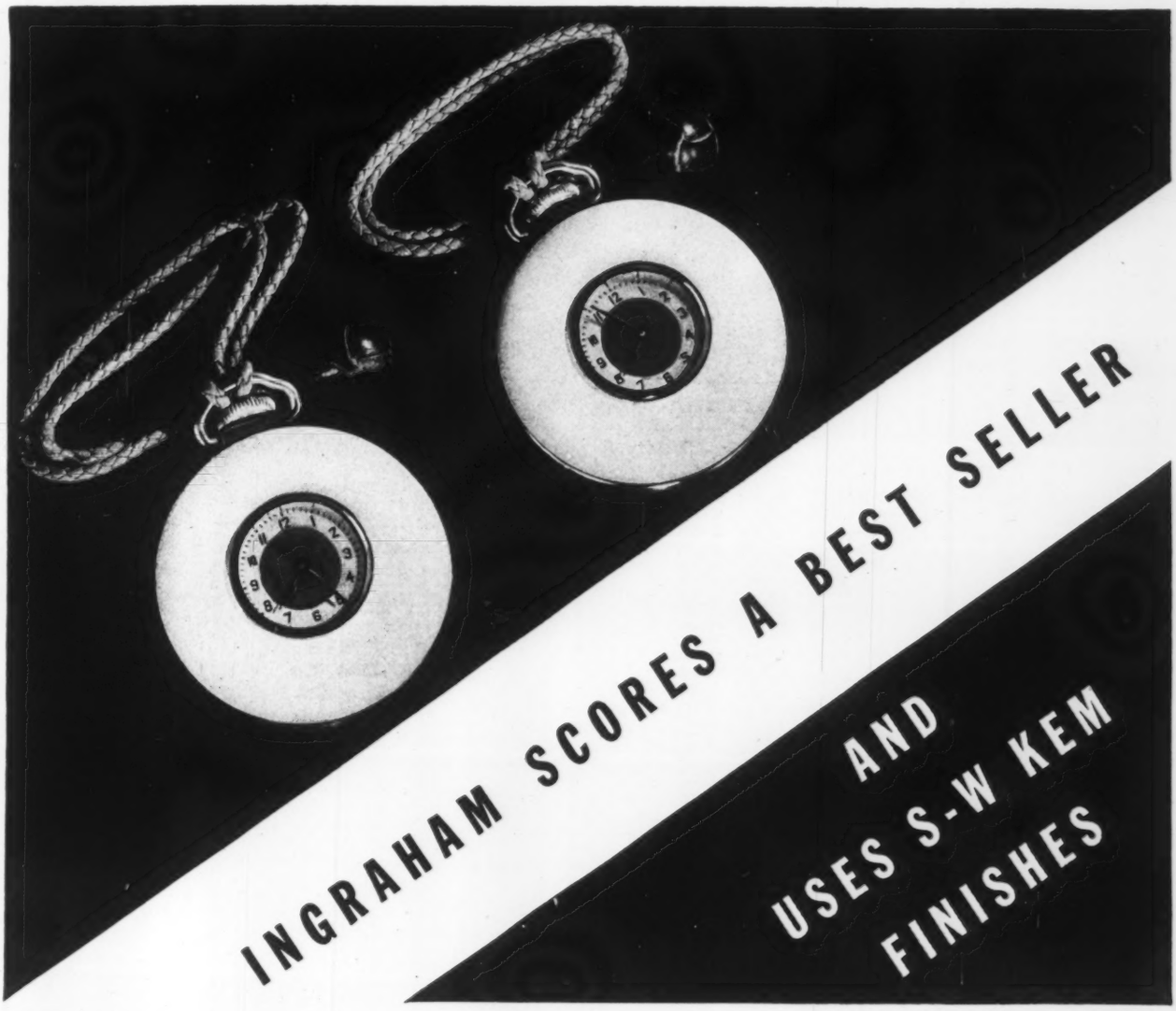
ALLOYS—(STEEL) — In a recent folder of American Manganese Steel Co., Chicago Heights, Ill., are shown a group of manganese alloy castings made for numerous industrial purposes where this material is employed to withstand extreme temperatures and the destructive action of acids, gases and corrosive liquids.

ALLOYS (STEEL)—Properties and applications of heat-resistant alloy steel castings, centrifugal castings, and castings for steel mill use are discussed in a bulletin prepared by Michiana Products Corp., Michigan City, Ind. The tables and curves included in this bulletin give data on the chemical analysis of various alloys, heat treatment, creep rates and similar points of interest.

ALLOYS (STEEL)—American Rolling Mill Co., Middletown, O., has prepared two folders entitled "Solve High Temperature Problems" and "12 Stars of the Stainless Steel Firmament." The first of these gives information on Armco stainless steel, such as its strength at high temperatures, corrosion resistance and physical properties. The second lists 12 different Armco stainless steels, their characteristics and uses.

ALLOYS (STEEL)—A series of five well prepared booklets on Enduro stainless steel has been released by Republic Steel Corp., Republic building, Cleveland. The booklets illustrate the more important applications of the alloy; include a chart listing analyses and detailed properties of 13 principal types of Enduro; give detailed data on 18-8 and its several variations; present the straight-chromium and the heat-resisting types, and treat 4-6 per cent chromium steels. These latter steels are not stainless but are intermediate between ordinary carbon and stainless steel.

CONTROLLERS — Automatic Temperature Control Co., 34 East Logan street, Philadelphia, has issued a bulletin entitled, "Industrial Controls — Regulating Temperature, Time, Level, Flow, Pressure." This pub-



Ingraham's new Lapel Watch is eclipsing all sales records—attributed to the smart new case created by Aristocrat Clock Co., N. Y., distributors, and to the remarkable beauty and durability of the finishes applied—S-W Kem Art Metal Finish in a fine, even texture and S-W Kem Baking Enamels in a high gloss.

Comments H. S. Products Finishing Co., Brooklyn, N. Y., "Kem Art Metal and Kem Baking Enamels are so far ahead of similar type finishes that they are in a class by themselves.

"The easy handling and uniformity of these finishes in color, body, spraying and baking qualities makes possible the finishing of these watch cases by special automatic spray equipment at the rate of more than 4,000 per hour and thus helps to bring the cost of finishing well below that possible where less highly developed materials are used."

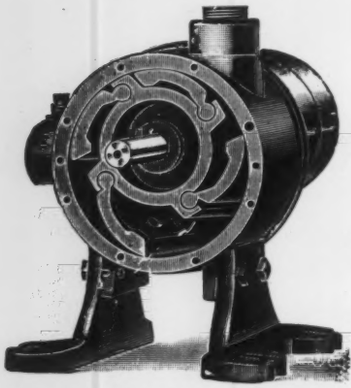
Why not give your products the added beauty and protection of a Sherwin-Williams Finish? The Sherwin-Williams Design Service and Finishing Engineers are your constant aid—without cost or obligation—in developing effective color treatments and finishes to give your product a greater appeal in today's market and at the minimum final finishing cost. Write The Sherwin-Williams Co., Cleveland, Ohio and all principal cities.

SHERWIN-WILLIAMS FINISHES

SEE THE SHERWIN-WILLIAMS FINISHING ENGINEER

THE MACHINE DESIGNERS' FAVORITE AIR PUMP

Favorite because of its numerous sizes, its simple lines of construction, but above all because of its reliability —its positive performance which—just because it is so simple in design—can never fail to give its best.



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Patented Rotary Positive
AIR PUMPS
for pressure, vacuum and gas pumping

They Take Up Their Own Wear

Used on all worth-while automatic machines, paper feeders, bottle fillers, oil burners, and gas appliances.

Aerating — Agitating — — Printing Presses — Oil Furnaces — Gas Furnaces — Coal Furnaces — Suction Chucks — Vacuum Cleaning — Solder Iron Heaters — Wrapping Machines — Mailing Machines — Testing Gas Fittings — Removing Foul Air — Supplying Fresh Air — Melting — Hardening — Massaging Machines — Laboratory Work — Blow Lamps — Blow Pipes — Glass Blowing — Gas Pumping — Testing Meters — Pressing Irons — Vacuum Frames Singeing — Branding — Preheating — Assaying — Brazing — Annealing — Soldering — Forging — Calliopes — Milking Machines — Steam Heating Systems — Paper Feeding Devices

LEIMAN BROS., INC.

177 (11) Christie St., Newark, N. J.
LEIMAN BROS. N. Y. CORP. 23 (P11) Walker St., New York, N. Y.
Makers of Good Machinery for 45 Years

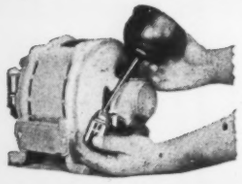
CONSTANT OIL LEVEL ***Always***

. . . and reliable too

Gits Constant Level Oilers will at all times maintain a correct oil level in motor bearing reservoirs, that will never permit oil to rise higher than the proper level, eliminating any chance of flooding the bearings or motor windings.

Send for specially prepared catalog.

Exclusive Feature — unbreakable bottle hinges to cup. No danger of spilling. Bottle returns in upright position without loss of oil.



GITS BROS MANUFACTURING CO.
1861 S. KILBOURN AVE., CHICAGO

lication covers motor-operated controllers, valves, timers and current-input controllers. Another publication of the company gives data on an automatic reset cam timer, series 2500, which resets starting position of power failure.

CONTROLLERS — The new air-operated controller for the governing of temperature, pressure, flow and liquid level is thoroughly covered in Catalog No. 8901 recently published by Brown Instrument Co., Philadelphia. This catalog illustrates and describes all of the controllers in this company's line.

CONTROLS (ELECTRICAL) — Major features in the design of a new A. C. automatic starter are given in a bulletin published by Square D Co., Milwaukee, Wis. This starter is of line voltage type and can be used with polyphase squirrel cage motors when application permits.

DESIGN DEPARTMENT—Eugene Dietzgen Co., Chicago, has issued a pamphlet announcing its improved drawing ink, available in ten colors in addition to black. This pamphlet presents the new features of the ink.

DESIGN DEPARTMENT—A course in development engineering which gives training in producing original ideas is presented in a booklet of Trofimov School of Inventive Practice Inc., 3859 Northhampton Road, Cleveland Heights, O. This course on development engineering is described as an application of the theory and technique of inventive practice to engineering. It is said to approach and solve systematically technical problems of all varieties.

DRIVES — Bulletin No. 20, prepared by Ajax Flexible Coupling Co., Westfield, N. Y., covers reciprocating drives for screens, conveyors and feeders. This bulletin contains drawings, diagrams, and tabular matter covering the reciprocating drive.

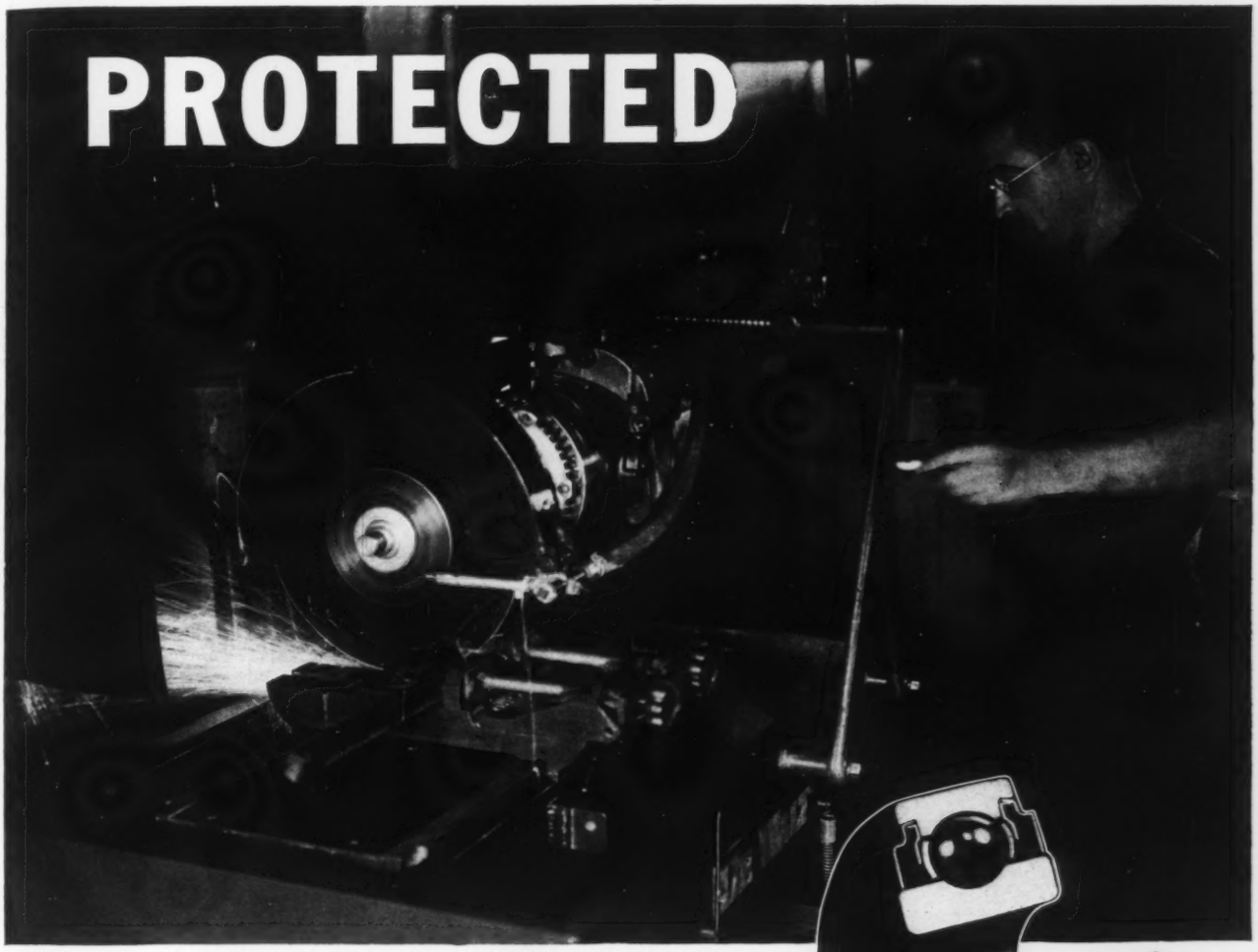
DRIVES — Two new data books, No. 782 for multiple groove drives and No. 783 for fractional horsepower single groove drives, issued by Rockwood Mfg. Co., 1801-2001 English avenue, Indianapolis, are designed to assist the designer in his selection of the proper drive. The numerous tables in these booklets list in a simple manner the type of V-Belts and sheaves to be used for specific average requirements. The range covered is from fractional to 500 horsepower.

ENGINEERING DEPARTMENT—Another feature edded to the three sizes of printed tracing vellum, made by Drafto Co., Cochranton, Pa., which already have the most essential headings, is the imprinting of user's name and address in the title corner of the Standard Drafto form.

FASTENING—Publication of a new folder, Bulletin No. 833, covering Bristo screw products has recently been announced by the mill supply division of Bristol Co., Waterbury, Conn. Sizes, etc. for socket setscrews, socket head cap screws, stripper bolts, and pipe plugs are listed.

FINISHES—The new Tocco process which hardens metal surfaces quickly, inexpensively and with accurate and uniform results is described in a folder recently prepared by Ohio Crankshaft Co., Cleveland. This method requires the heating of only that portion of any metal part which needs hardening—and only the surface of

The Motor *Bearings*, too, must be



SWIFT, clean cutting of both hard and soft metals is the daily task of DeWalt Metal Cutters. And where abrasive shears into metal at high speed, emery and steel dust whirls and flies. The machine must be so designed that every moving part is protected.

The bearings of the motor, too, must be proof against dust. BCA Composition Seal Bearings were a logical choice and DeWalt has made them standard equipment. The snugness of this new seal keeps out even microscopic particles, thereby substantially extending the life of the motor.

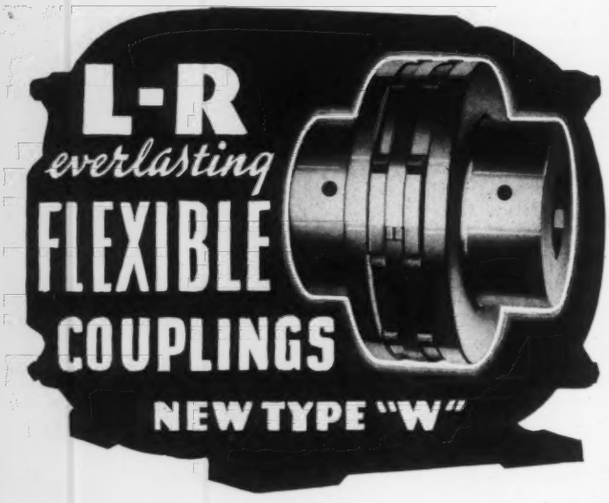
If your machines or motors are exposed to dust, they deserve the same protection given this DeWalt Metal Cutter. There is a BCA Seal Bearing designed precisely for your needs—one that will safeguard machine efficiency, cut lubrication costs and reduce the hours the machine must be idle for cleaning.

A study by BCA engineers of your products may reveal opportunities for manufacturing economies. Feel free to get in touch with them at any time. BEARINGS COMPANY OF AMERICA, 517 HARRISBURG AVENUE, LANCASTER, PENNSYLVANIA

BCA

RADIAL · THRUST · ANGULAR CONTACT

BALL BEARINGS

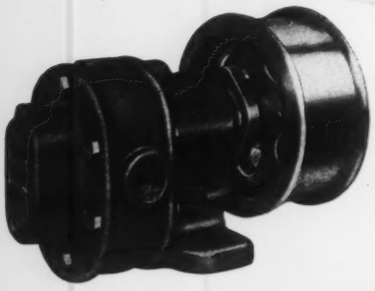


For Longer Machine Life and Smoother Operation

As standard equipment on direct drive machine units L-R Type "W" FLEXIBLE COUPLINGS have given yeoman service for many manufacturers and their users. Shock loads are almost fully absorbed. Load cushions last much longer than others, and can be changed without tearing down coupling. Non-lubricated. Bores 2" to 14". Other types, 3/16" up. Write for engineering data.

LOVEJOY TOOL WORKS
5018 West Lake St. Chicago, Ill.

Use *HELICAL GEARED* Pumps for — High Speeds — Quietness



Nos. 1S-2S-3S

—a new design with renewable bearings that permits operation at usual motor speeds.

Nos. 53-55

—a ball bearing pump giving large volumes at high pressures for supplying oil for hydraulic operation of machinery.

Brown & Sharpe Mfg. Co., Providence, R. I.

BROWN & SHARPE PUMPS

B·S

that portion. The heated surface is then quenched by a water spray.

FINISHES—Specifications, methods of use and advantages of Cadalyte, a process and product for cadmium plating, are presented in a catalog recently published by Grasselli Chemical Co. Inc., 629 Euclid avenue, Cleveland.

FINISHES—Detailed methods for application of sodium cyanide solutions in prepartion of metal surfaces for finishing are given in a manual recently announced by the R. & H. Chemicals department of E. I. du Pont de Nemours & Co. Inc., Wilmington, Del.

HYDRAULIC EQUIPMENT—An illustrated bulletin, issued by Racine Tool & Machine Co., Racine, Wis., describes hydraulic pumps manufactured by this company which are of variable delivery, radial vane type. Volume from zero to maximum is controlled manually by positive lever control; mechanically by means of dogs, cams or other mechanical arrangements; and automatically by means of a hydraulic governor which varies delivery in accordance with pressure built up in the system and maintains any constant pressure desired without the by-passing of oil.

LUBRICATION AND LUBRICATING EQUIPMENT—Madison-Kipp Corp., 20 Waubesa street, Madison, Wis., recently published a bulletin covering its complete line of independent motor-driven lubricator units. This unit may be used as a centralized lubrication system for a number of machines, or for a detached installation for any machine where heat or other adverse operating conditions make a close-to-the-machine application impractical.

PACKING GLANDS AND PACKING—Complete information on shim-seals has been made available in brochure form by National Motor Bearing Co., 1199 Seventy-eighth street, Oakland, Calif. These seals are employed to gain exact tolerance and lubricant sealing with one part. The highly technical subject is presented in a simplified form.

PACKING GLANDS AND PACKING—In the new catalog issued by Garlock Packing Co., Palmyra, N. Y., self-contained unit oil seals are discussed, with respect to types and sizes available, their characteristics, and typical applications. This seal is designed to retain oil and grease, and to exclude dust, dirt or any foreign matter from a bearing. The book includes cross sectional drawings and complete selection tables.

PLASTICS—A booklet No. B.2063 covering the industrial uses of Micarta, its mechanical and electrical properties, standard forms available, specific application in electric manufacturing, radio, aircraft, automobiles, paper mills, steel mills, textile mills, chemical plants, etc., has recently been issued by the Micarta Works of Westinghouse Electric & Mfg. Co., Trafford, Pa.

RUBBER—United States Rubber Products Inc., 1790 Broadway, New York, has issued a practical manual on the application of rubber mountings to modern industrial use. This manual will serve as a ready reference for engineers, plant operators and executives as it gives complete engineering data indicating the various characteris-

Better . . because it's *Alloy Steel*

This modern combined mine skip and hoisting cage is *better because it's alloy steel!* Made of a high-tensile mild-alloy steel containing manganese and silicon, it *weighs 30 per cent less* than the steel lift it replaces. This enables the mine to operate 800 feet below its present floor without overloading its hoisting machinery.

In thousands of other applications, the extra strength of alloy steels decreases dead weight, increases pay load, lowers maintenance, and lengthens life. If you want to give your equipment or product this extra value, investigate the possibilities of alloy steels.

Electromet, through thirty years' practical experience with ferro-alloys and alloy steels, can give you unbiased help in selecting the right alloy steel for your purpose. Electromet is not a manufacturer of alloy steels, and favors no one producer or product. Avail yourself of this service. You may profit and will not obligate yourself. Write for further information.

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Unit of Union Carbide and Carbon Corporation
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CARBIDE & CARBON BUILDING **Electromet** 30 EAST 42nd ST., NEW YORK, N. Y.
Ferro-Alloys & Metals

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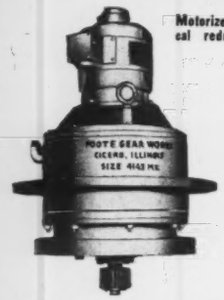


Motorized vertical helical reducer 4143-MV

Motorized double worm gear variable speed reducer 7-28-D

the above are among the many installations made by the Foote Gear Works Inc., and now doing service satisfactorily in plants throughout the country.

The vertical helical is one of 32 units installed to drive agitators in 126 foot diameter digester tank ½ H.P. motor—1200 RPM—ratio 80½ to 1. Installation made in southwest sewage disposal plant, Chicago Sanitary District.

128 page data book FREE

send for your copy to

FOOTE GEAR WORKS, INC.

Cut Gears Of All Kinds.

1301 S. Cicero Av., Cicero, Ill.

LAMINUM SHIMS not only save in the original precision assembly of bearings . . . they add a selling feature by providing for quick, accurate service adjustments FOR THE LIFE OF THE BEARING! They save precision machining and fitting . . . adjustments are made right at the machine by simply p-e-e-l-i-n-g one or more .002" laminations from the solid shim. Write for a sample of LAMINUM.

LAMINUM
Precision adjustment SHIMS

LAMINATED SHIM CO., 21-26 44TH AVE., LONG ISLAND CITY, N. Y.

tics of rubber, graphs showing its deflection curves, and its safety load limits.

TUBING—Synthane Corp., Oaks, Pa., has published an interesting 6-page folder on the grades; physical, chemical, mechanical and electrical properties; shapes and characteristics of laminated bakelite tubing. The bulletin includes a quick-reference comparison chart of test values of rolled and molded tubes, showing the tensile, compressive (axial and radial) and dielectric strengths, moisture absorption, power factor and dielectric constant.

WELDED PARTS AND EQUIPMENT—A number of file sheets covering welding applications in the structure of parts of machinery have been issued by Lincoln Electric Co., Cleveland. These sheets contain numerous drawings illustrating these parts.

WELDED PARTS AND EQUIPMENT—In a profusely illustrated bulletin entitled "Welding and Cutting," prepared by Air Reduction Sales Co., 60 East Forty-second street, New York, is given a practical demonstration of gas and electric welding, and hand and machine gas cutting. Latest developments in application and equipment are also shown and described.

WELDED PARTS AND EQUIPMENT—Lincoln Electric Co., Cleveland, is distributing bulletin No. 412 discussing a new arc welding technique in connection with its new "Shield-Arc S.A.E." welding machine which enables the welder to select the exact type of arc required for every welding current.

Research Publications

NEMA Electric Arc-Welding Machine Standards. This publication is a reference work of practical information concerning the manufacture, test and performance of direct and alternating current arc welding machines; such as, motor-generator sets, dynamotors, transformers and rectifier arc welding units. Published by National Electrical Mfg. association, 155 East Forty-fourth street, New York, 50 cents.

Symposium on High Temperature Melting of Cast Iron, compiled by Frederick G. Sefing and M. F. Surls. Made up of technical papers presented at an engineering meeting, this publication includes "Structures of Gray Iron and Their Effects on Physical Properties," by Victor A. Crosby; "The Effect of Superheating Temperatures Alone on Gray Iron Mixtures," by Armand DiGiulio; "Discussion," by H. W. Gillett; "Specific Results of Superheating a Particular Gray Iron," by F. J. Walls and T. J. Wood; "The Effect of Time at Superheating Temperatures at Gray Iron Mixtures," by H. S. Austin; "Relation Between Superheating, size of Section and Structure," by Harry Rayner; "The Influence of High Furnace Temperatures on the Chemical Analysis and the Effects of Small Changes in Chemical Analysis on the Physical Properties," by R. G. McElwee; "Discussion," by R. A. Clark; and "Closure of the Conference," by F. G. Sefing and M. F. Surls. Published as bulletin No. 69 by Michigan Engineering Experiment Station, Michigan State college, East Lansing, Mich., 34 pp. 25 cents.

TO KEEP DOWN UPKEEP

...SPECIFY

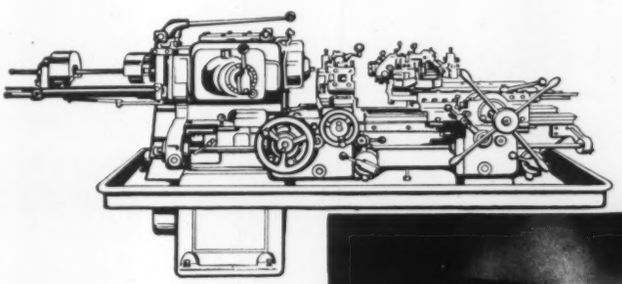
HYATT

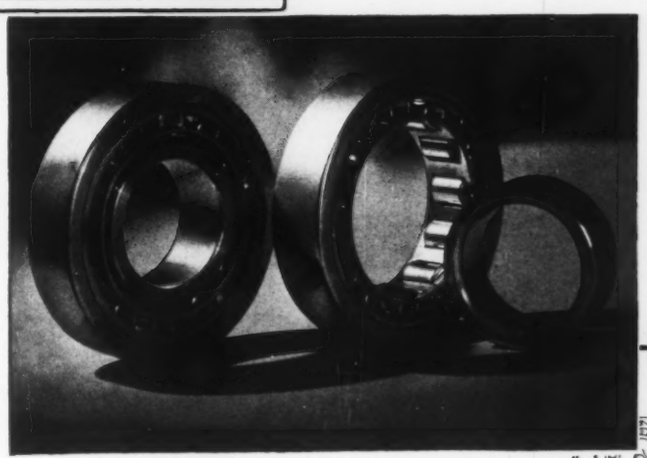
Roller Bearings

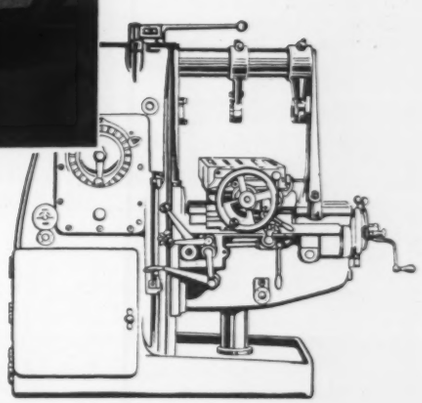
Each year machines are operated faster and harder... and each year finds more and more Hyatt Roller Bearings carrying the load. Dependable bearings that help keep down upkeep. Precision bearings, which users know measure up to the excellence of the design of their own equipment. That is why Hyatts are used so generously and why the purchaser of these machines places such confidence in Hyatt applications.

• • •

Hyatt Roller Bearing Company, Newark, Detroit, Chicago, Pittsburgh, San Francisco. In Europe, 111 Grosvenor Rd., London, S.W. 1.







The Hyatt Hy-Load Solid Roller Radial Bearing is setting a new standard of accuracy for anti-friction bearing use in **MACHINE TOOLS.** The ideal bearing for load carrying capacity where it is most needed, accurate gear alignment, silent operation, and wear minimizing.

The
BROWNIE
COOLANT PUMP
HIGH CAPACITY - LOW
HORSEPOWER INPUT
OPEN
TYPE
CLOSED
TYPE
Designed to pump lapping compound that would wreck the ordinary pump, these improved models possess a minimum of parts; no packings to leak and no screens to clog.
Shaft-whip-friction has been eliminated by placement of a ball bearing within one inch of impeller permitting self-alignment . . . May we mail description bulletin on the new economical BROWNIE pump?

THE TOMKINS-JOHNSON CO.
JACKSON MICHIGAN

Consider the Itemized Index!

All drive developments in this issue are listed on page 7.

Every reference to materials as used in machinery can be located through page 7.

Individual design problems are classified for maximum utility, on page 7.

In every issue of MACHINE DESIGN the problems, parts, materials, mechanisms, in short, every detail covered by that issue is carefully *Itemized.*

Increasing reference is being made to the Itemized Index by alert engineers as a regular part of their design procedure.

SEE PAGE 7!

Topics

(*Concluded from Page* 24)

prints which match incoming prints. The lawyers will have to work fast to get their man out of jail before this machine gives away his past record.

♦ ♦ ♦

Of special interest during the introduction of new automobile models is the revival of the three-wheel design. Although not yet in production, this car has been successfully tried out and is said to overcome the defects of previous three-wheel models. An eight-cylinder motor mounted at the rear drives on the two front wheels, and steering is done on the single rear wheel. The car is shaped like a tear-drop, following the lines of least resistance to natural air flow.

♦ ♦ ♦

Perhaps you won't be able to incorporate this development into your machine immediately, but the idea behind the effort proves a point that you can well remember. Strips of two alloys, Copnic and Chromel, were welded together and rolled to a thickness of six millionths of an inch recently in the General Electric laboratories. Even when magnified 250 times the weld in the ultra-thin bimetallic foil can be distinguished only by the difference in color between the two alloys. Gold has been beaten to four millionths of an inch, and aluminum has been thinned by the same treatment to ten millionths of an inch; but this is the first time two alloys have been welded together and then reduced to such a thin section by rolling.

♦ ♦ ♦

Of interest to designers of machines which must resist many and varying substances and yet not contaminate those substances is a recently introduced process for spraying a glass lining on to a metal surface. Nothing that comes into contact with glass, except enough heat to cause remelting and hydrofluoric acid, affects the substance or is affected by it, so it is an ideal protective coating. When a bond is assured by preparing the surface, several layers of glass may be sprayed on to build up the thickness required.

♦ ♦ ♦

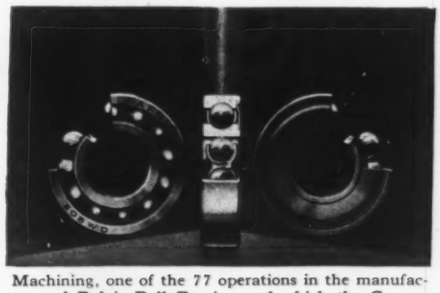
There are two general plans to follow in designing in a special field. One is to make your machine as different as possible from all others and try to bring out as many varying sizes as possible. Another, and to our mind a better, way is to co-operate to limit the number of sizes and concentrate on producing equipment of better quality than the competition. Concrete mixer designers have followed this second plan. They have reduced the sizes of these mixers from thirteen to six in the building industry and from six to two in the paying industry. Engineering skill and resources have been turned to increasing the efficiency of the standard sizes.

♦ ♦ ♦

Manufacturers of machine tools have long pointed out how the new units would pay for themselves in savings. Now a machine has been designed by Westinghouse engineers that doesn't produce anything, yet saves its cost by savings anyway. It is an electrostatic dust precipitator which snares "pay dirt" electrically. The device, used with automatic dish making machines, saves particles as small as one micron in size, collects the glaze and feeds it back into the machine with only a minimum of cleaning required.

. . . *down your friction losses*

The life of your machinery and your power transmission equipment depends in large measure on the quality of the anti-friction bearings used. Fafnir Ball Bearings, made from tough, special-formula steel, are machined, ground and polished to exceedingly close tolerances. To the user, Fafnir's accurate deep-race contours and surfaces mean few replacements and low maintenance costs—for the meticulous attention to detail so characteristic of Fafnir workmanship pays extra dividends in the long run.



Machining, one of the 77 operations in the manufacture of Fafnir Ball Bearings, of which the Grease-Shield Bearing is a representative type.

The correct ball bearing for each job will do more than any one other thing to minimize power losses in machinery. The right Fafnir makes possible full utilization of the productive capacity of plant or machine. Fafnir engineers, with a quarter century of service behind them, will help you to select this right type. . . . The Fafnir Bearing Company, *New Britain, Connecticut.* . . . Atlanta . . . Chicago . . . Cleveland . . . Dallas . . . Detroit . . . Kansas City . . . Los Angeles . . . New York . . . Philadelphia . . . Seattle.

FAFNIR

BALL BEARINGS

Business and Sales Briefs . . . . . .

S. R. THOMAS, for the past four years chief engineer of the Cord automotive interests in the connection with the construction of the Auburn, Cord and Dusenberg cars, has been appointed manager of the automotive bearing division of Bantam Ball Bearing Co., South Bend, Ind.

* * *

The Linde Air Products Co., New York city, has opened a new district office at 2 Virginia street, Charleston, W. Va., with A. R. O'Neal as district manager.

* * *

Frank J. Boehm, formerly with Steel & Tubes Inc., has been appointed general sales manager of the Jackson Tube Co. Inc., Brooklyn.

* * *

Cutler-Hammer Inc., Milwaukee, Wis., has announced the opening of a West coast office at the new plant located at 970 Folsom street, San Francisco, where operations have already begun.

* * *

Frank N. Satter recently was appointed district manager of sales for Cleveland and Youngstown, O., by Lawrenceville Bronze Co., Pittsburgh. He will be located at 3030 Euclid avenue, Cleveland.

* * *

Clarence W. Howatt, formerly vice president of Pittsburgh Steel Foundry Corp., Glassport, Pa., has become associated with Erie Foundry Co., Erie, Pa., as Pittsburgh sales representative with offices in the Grant building, Pittsburgh.

* * *

Woods Sanford has resigned as advertising manager of Harnischfeger Corp., Milwaukee, to join the sales force of Chain Belt Co., Milwaukee. Edward Slackford, who has for ten years been engaged in industrial advertising in both manufacturing and agency work, will succeed Mr. Sanford as advertising manager of the Harnischfeger company.

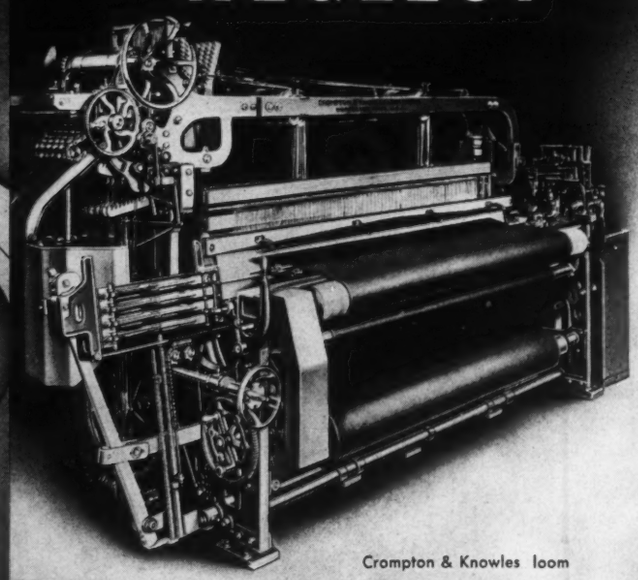
* * *

Charles A. Kropp has resigned as president of the Kropp Forge Co., Chicago, but will continue active connections with the company in the capacity of chairman of the board of directors. Roy A. Kropp, who has devoted his entire business career to the modernization of production methods for drop and hammer forging, succeeds him as president.

* * *

H. D. Whittlesey will relinquish his duties as director of sales and distribution and will devote his time to executive duties as first vice president of Sherwin-Williams Co., Midland building, Cleveland, to further interests of the company's allied connections. Other promotions in-

INSURING YOU AGAINST NEGLECT



Crompton & Knowles loom

The correct oil film to each individual bearing... automatically

BIJUR

AUTOMATICALLY Correct LUBRICATION

● Expensive "I-forgot's"... the faults of any imperfectly controlled method of lubrication . . . may heavily burden maintenance and production costs. BIJUR lubricating systems unfailingly protect your machine against such neglect . . . Insure, too, the soundness of your investment. Each bearing, whatever its size, speed and load, is automatically fed the amount of oil it individually requires!

BIJUR LUBRICATING CORPORATION

LONG ISLAND CITY NEW YORK

clude A. W. Steudel, appointed as vice president and general manager, and K. H. Wood, who becomes director of sales and distribution of the company.

* * *

J. E. Littleton has been appointed representative in the Columbus, O., territory for the Peninsular Steel Co., Cleveland, with offices at 35 East Gay street, Columbus, O.

* * *

Twin Disc Clutch Co., Racine, Wis., has expanded its facilities with the addition of a new plant in Rockford, Ill.

* * *

Wilson Miles Cary Jr. has been added to the sales force of Pittsburgh Screw & Bolt Corp., with offices at 630 Fifth avenue, New York. He was formerly with Jeffrey Mfg. Co., Columbus, O.

* * *

Headquarters of H. E. Eaton Co., Eastern sales representatives for New York and New England for Michigan Tool Co., Colonial Broach Co., and Detroit Tap & Tool Co., have been moved to 51 East Forty-second street, New York.

* * *

Hanson T. Thomas, formerly vice president and general manager of sales of Oliver Iron & Steel Corp., Pittsburgh, has joined the staff of Russell, Burdsall & Ward Bolt & Nut Co., in the company's Philadelphia office.

* * *

Clarence Guthridge has been appointed general manager of sales of the Oliver Iron & Steel Corp., Pittsburgh. Theodore F. Smith has been appointed vice president in charge of sales for the company and continues also as secretary.

* * *

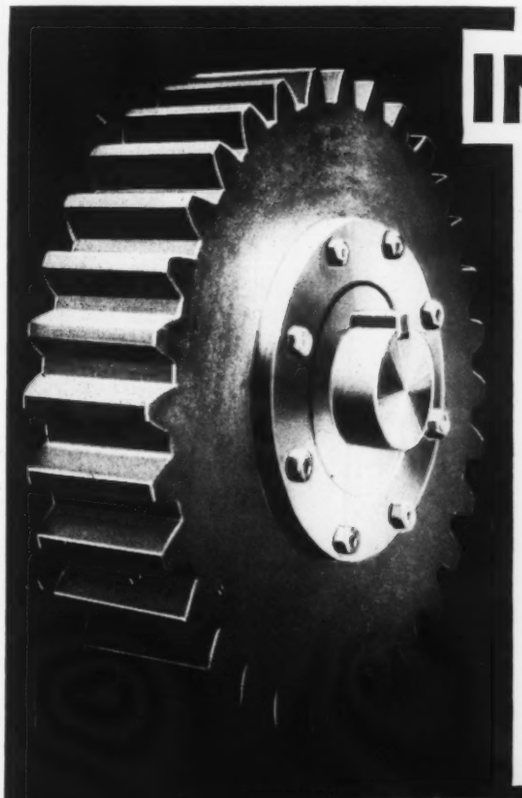
H. W. Harman, head of the engineering and research departments of the Stearns Magnetic Mfg. Co., Milwaukee, has been transferred to the sales department as sales engineer with supervision of the purchasing department. The Stearns plant has been enlarged to provide increased production facilities in the main fabricating and erecting departments.

* * *

Thor M. Olson has recently been appointed sales manager of Ex-Cell-O Aircraft & Tool Corp., Detroit, succeeding William F. Wise. Mr. Olson served as general manager of Continental Tool Works since its foundation until shortly before it was acquired in 1930 by the Ex-Cell-O company, when he became president. Later, after becoming associated with the Ex-Cell-O company, Mr. Olson became vice president and director on the board.

* * *

Lee M. Hogan, former manager of advertising and sales promotion of Steel & Tubes Inc., a subsidiary of Republic Steel Corp., Cleveland, has been appointed district sales manager of the New York district. Irving Whitehouse, who formerly was assistant manager, has been named manager of sales promotion. A. R. Smith has been promoted to general manager of the Elyria division of Steel & Tubes Inc., succeeding A. E. Adams, retired. Mr. Smith was formerly superintendent of this division.



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are Silent, Durable, Economical

ENGINEERS and designers are using more and more INSUROK Gears in modern production machinery because of their many outstanding, desirable qualities. INSUROK Gears are light in weight, yet amazingly strong and tough. They do not corrode or deteriorate, chemically resist most acids, solvents, reagents, oils and other liquids. Their resiliency makes them natural shock absorbers. Vibration, noise and screech are eliminated. They outwear metals many times over. The result is a more efficient operating machine, freedom from costly upkeep, repairs and replacements, and assured uninterrupted performance.

DESIGN, RESEARCH AND ENGINEERING LABORATORIES are maintained by Richardson, largest manufacturers devoted exclusively to the plastic arts, to assist in the application of INSUROK to all types of finished products and production equipment. Using this service obligates you in no way.

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